PAGE'S WEEKLY.—December 22, 1905.

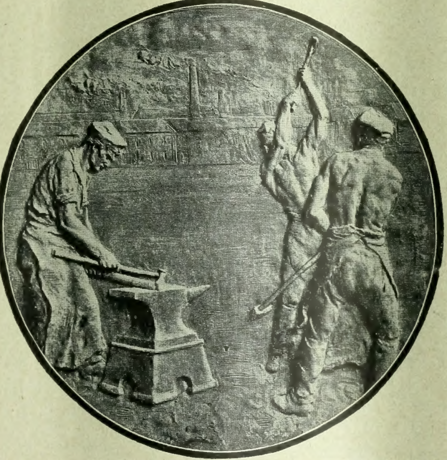
Thin Paper Copy for Circulation Abroad.

No. 67. VOL. 7.

SIXPENCE.
(REGISTERED AS A NEWSPAPER.)

FRIDAY,
DECEMBER 22, 1905.

PAGE'S WEEKLY



ENGINEERING · ELECTRICITY
SHIPBUILDING MINING
IRON & STEEL INDUSTRIES

EDITORIAL & PUBLISHING OFFICES, CLUN HOUSE, SURREY STREET, STRAND, LONDON, W.C.

FRANCE, Paris : 22, Rue de la Banque.
GERMANY, Berlin : 13, Unter den Linden.
RUSSIA, St. Petersburg : 14, Nevsky Prospect.
ITALY, Rome : 307 Corso.
AUSTRIA, Vienna : Kärntnerstrasse, nr. 30.

INDIA, Calcutta : Thacker, Spink & Co.
" Bombay : Thacker & Co., Ltd.
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JAPAN, Yokohama : Kelly & Walsh, Ltd.
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PAGE'S WEEKLY Miscellaneous

PAGE'S WEEKLY — Miscellaneous

PAGE'S WEEKLY. Miscellaneous

"ZECO" Brand. | **Blue Planished and Glazed Steel Sheets for Lagging and Covering generally.**

ZEITZ & Co., 21, Lime St., London, E.C.

Melville and Macalpine, Consulting Engineers and NAVAL ARCHITECTS, 615, WALNUT STREET, PHILADELPHIA, PA., U.S.A. Rear-Admiral GEORGE W. MELVILLE, Ex-Engineer-in-Chief of the United States Navy, and JOHN H. MACALPINE, having a very extensive acquaintance in the best engineering circles in the United States, Britain, and the Continent of Europe, especially SOLICIT INTERNATIONAL BUSINESS

Refuse Destructors.

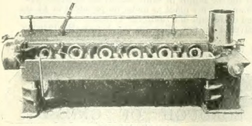
Write for particulars to:—

HEENAN & FROUDE, LIMITED,

4, Chapel Walks, MANCHESTER.

Works: MANCHESTER and WORCESTER.

ED. BRAND, 35, Shakespeare St., MANCHESTER.

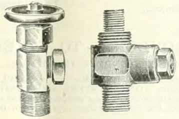


INQUIRIES SOLICITED.

Telegraphic Address: "Filieres, Manchester."

Patent Continuous Wire-Drawing Machine.

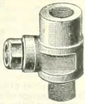
Modern Wire-Working Machinery,
Complete Wire-Drawing Plants, Draw Benches, Galvanising, Tinning, and Annealing Plants.



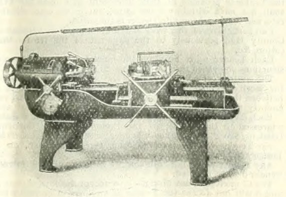
The
Scotch & Irish Oxygen Co., Ltd.,
ROSEHILL WORKS, GLASGOW.

Valves for Gas Bottles, Refrigerating Plant, etc., in Bronze, Steel, and Aluminium.

Reducing Valves, Keys, and all Fittings for Compressed Gases.



HARTNESS FLAT TURRET LATHE



The only Turret Lathe with Cross-Sliding Head.

JONES & LAMSON MACHINE CO.,
"JUBILEE BUILDINGS,"
97, Queen Victoria Street, LONDON.

JOSEPH BOOTH BROS., LTD., RODLEY, LEEDS. See next week.

LIFTING MACHINERY.

THOS. W. WARD, ALBION WORKS, SHEFFIELD. See Page 17.

MACHINE TOOLS.

THE SHANNON, LTD., Ropemaker St., London, E.C. See Page 68.

OFFICE APPLIANCES.

Have you seen our Advertisement on page ~~69~~ 49? A glance at it may save you £500 per annum.—ED. BENNIS & CO., Ltd., BOLTON.

PAGE'S WEEKLY Contracts

CONTRACTS.

ELHAM UNION.—TO BOILERMAKERS, ETC.

The Guardians of this Union REQUIRE a LANCASHIRE BOILER.

Tenders are invited for the supply of same according to a Specification which can be obtained at my office as under, on payment of £1 1s. which will be returned on receipt of a *bona fide* Tender.

Tenders to be delivered at my office on or before Wednesday, December 27th.

The Guardians do not bind themselves to accept the lowest or any Tender.

R. LONERGAN, Clerk.

11, Cheriton Place, Folkestone,
November 28th, 1905.

ELHAM UNION.—TO MAKERS OF SUPERHEATERS.

The Guardians of this Union REQUIRE one or more SUPERHEATERS.

Tenders are invited for the supply of same, according to a Specification which can be obtained at my office as under on payment of £1 1s. which will be returned on receipt of a *bona fide* Tender.

Tenders to be delivered at my office on or before Wednesday December 27th.

The Guardians do not bind themselves to accept the lowest or any Tender.

R. LONERGAN, Clerk.

11, Cheriton Place, Folkestone,
November 28th, 1905.

COUNTY BOROUGH OF GRIMSBY.

ELECTRICITY DEPARTMENT.

The Grimsby Corporation are prepared to receive TENDERS for PLANT, BUILDINGS, and CABLES to the following Specifications :—

Specification No. 35.—Engine and Dynamo—500-kw. Continuous-Current Dynamo d.c to High-Speed Double Acting Engine.
" No. 36.—Water-Tube Boiler and Underfeed Stokers.
" No. 37.—Extension of Switchboard.
" No. 38.—Condensing Plant—Surface Type.
" No. 39.—Buildings—Bills of Quantities for Extension of Engine-room, New Coal Bunkers, and New Store.
" No. 43.—Pipework.
" No. 44.—Coal-Conveying Plant—Two Scraper Conveyors and One Elevator.
" No. 45.—Supply of Cables (Lead-Covered Paper-Insulated).

A Pamphlet giving full particulars of the above will be sent to any firm on receipt of a stamped addressed foolscap envelope.

Copies of the respective Specifications, General Conditions, and Drawings (if any) can be obtained from the undersigned on payment of a deposit of One Guinea on each Specification, which will be returned upon receipt of a *bona fide* Tender. Extra copies of the Specifications may be purchased at 2s. 6d. each, except Specification No. 39—Bill of Quantities, which may be purchased at 5s. each ; extra copies of Drawings 2s. 6d. each.

Tenders, on the prescribed form, in sealed envelopes, must be delivered to the undersigned not later than the first post, Friday, January 5th, 1906.

W. A. VIGNOLES,
Borough Electrical Engineer.

Corporation Electricity Works, Grimsby,
December 7th, 1905.

OAKENGATES URBAN DISTRICT COUNCIL.

WATERWORKS.

TO CONTRACTORS AND IRONFOUNDERS.

The above Council is prepared to receive TENDERS from competent persons for the PROVISION and LAYING of CAST IRON and other MAINS.

The Drawings may be seen and copies of the Specification, Bill of Quantities, and Form of Tender, may be obtained at the office of the Engineers, Messrs. R. E. W. BERRINGTON AND SON, Bank Buildings, Wolverhampton, on and after Wednesday December 20th, upon payment of Five Guineas, which will only be returned upon the receipt of a *bona fide* Tender.

Sealed Tenders, addressed to me, endorsed "Tender for Waterworks," must be delivered at my office before noon on Saturday January 20th, 1906.

The Council does not bind itself to accept the lowest or any Tender.

JNO. A. HOLMES, Solicitor,
Clerk to the Council.

Oakengates, December 13th, 1905.

CASTLEREA RURAL DISTRICT.

NOTICE.

BALLAGHADERREEN ELECTRIC LIGHTING.

The Rural District Council Castlerea, County of Roscommon, will, at their meeting to be held on Saturday, December 23rd, 1905, receive and consider TENDERS for the CONSTRUCTION of WORKS for Lighting the Town of Ballaghaderreen.

No. 1. Builders' Work in Constructing Houses, Weir Sluices, and Watercourse.
No. 2. Supplying and Erecting Hydraulic Turbine and Suction-Gas Engine Plant.
No. 3. Supplying and Erecting Electrical Work.

Specifications and Particulars may be had from CHRISTOPHER MULVANY, Esq., M.I.C.E., Engineer's Office, Athlone, on payment of One Pound as a deposit, returnable after receipt of *bona fide* Tender.

Sealed Tenders, giving the names of two solvent sureties willing to enter into a joint and several bond for the due performance of the Contract, and endorsed with the name of the Work, are to be addressed to the Presiding Chairman, District Council Office, Castlerea, and must reach the District Council Office not later than 12 o'clock noon on above-named day.

The Council do not bind themselves to accept the lowest or any Tender, or to defray any expense incurred in making the Tender.

By order,
P. A. FLANAGAN,
Clerk of the Council.

District Council Office, Castlerea,
November 18th, 1905.

CITY OF LAUNCESTON, TASMANIA.

ELECTRIC LIGHT DEPARTMENT.

TENDERS FOR SUPPLY OF METERS.

The MAYOR and ALDERMEN of the City of Launceston, Tasmania, are prepared to receive TENDERS for the SUPPLY of 500 or more ELECTRIC METERS and for MAXIMUM DEMAND INDICATORS.

Specifications and Conditions of Contract in duplicate may be obtained on application to Mr. WILLIAM CORIN, City Electrical Engineer, Launceston, Tasmania, or to Messrs. JOHN TERRY AND CO., 7, Great Winchester Street, London, E.C., England, on payment of Two Guineas, which sum will be refunded on receipt of a *bona fide* Tender.

Sealed Tenders, endorsed "Tenders for Supply of Electric Meters," must be addressed to the undersigned and lodged in his office not later than 12 o'clock noon of Monday, the 15th day of January, 1906.

C. W. ROCHER,
Town Clerk.

Town Hall, Launceston, Tasmania,
September 25th, 1905.

COUNTY OF LONDON.—TO STEEL RAIL MANUFACTURERS, ENGINEERS, AND OTHERS.

The London County Council invites TENDERS for the SUPPLY and DELIVERY of about 2,300 TONS of STEEL SLOT RAILS required in connection with the reconstruction, for electrical traction on the conduit system, of certain of the Council's tramways north of the Thames.

Persons desiring to submit Tenders may, on and after Monday, December 18th, 1905, obtain the Specification, Bill of Quantities, form of Tender, and other particulars, on application to the Engineer's Department, County Hall, Spring Gardens, S.W., upon payment to the Cashier of the Council of the sum of £2.

This amount will, after the Council or its Committee shall have come to a decision upon the Tenders received, but not before, be returned to the Tenderer, provided he shall have sent in a *bona fide* Tender and shall not have withdrawn the same, but in no case will the fee be returned unless a *bona fide* Tender is submitted.

Full particulars of the work may be obtained on application at the County Hall previously to the payment of the fee for the Specification, &c.

Each Tender must be upon the official form, and the printed instructions contained therein must be strictly complied with.

The contractors will be bound by the contract to pay to all workmen for work executed under the contract wages at the rates arranged between the employers and workmen in the rail trade in that part of the country where the order is placed.

Each Tender is to be delivered at the County Hall, in a sealed cover, addressed to the "Clerk of the London County Council, Spring Gardens, S.W.," and marked "Tender for Slot Rails, L.C.C. Tramways."

No Tender will be received after Ten o'clock a.m. on Tuesday, January 16th, 1906.

Any Tender which does not comply with the printed instructions for Tender may be rejected.

The Council does not bind itself to accept the lowest or any Tender and it will not accept the Tender of any person or firm who shall on any previous occasion have withdrawn a Tender after the same had been opened, unless the reasons for withdrawal were satisfactory to the Council.

G. L. GOMME,
Clerk of the London County Council.

County Hall,
Spring Gardens, S.W.,
December 15th, 1905.

PAGE'S WEEKLY Contracts and Appointments Open

COUNTY BOROUGH OF SALFORD.—

The Building and Bridges Committee of the Salford Corporation are prepared to receive TENDERS for the PROVISION and ERECTION of STEELWORK, WROUGHT and CAST IRONWORK, BRICKWORK, MASONRY, &c., required in the Reconstruction of Two Bridges carrying Frederick Road, Pendleton, over the Lancashire and Yorkshire Railway Co.'s line between Manchester and Bolton and the Manchester and Bolton and Bury Canal.

Drawings may be inspected at the offices of the Engineers, Messrs. C. S. ALLOTT AND SONS, 46, Brown Street, Manchester, and a copy of the Specification, Bill of Quantities, and Form of Tender may be obtained on the payment of the sum of Two Guineas, which will be returned on receipt of a *bona fide* Tender.

Tenders, duly endorsed (in the envelope provided), to be delivered at my office not later than 12 noon on Wednesday, December 27th, 1905.

The Corporation do not bind themselves to accept the lowest or any Tender.

Town Hall, Salford, (Signed) L. C. EVANS,
December 8th, 1905. Town Clerk.

TO WELL-BORERS AND CONTRACTORS.

The PARISH COUNCIL of BOCKING, near Braintree, Essex, invite TENDERS for SINKING a BOREHOLE and LINING same with STEEL TUBES for the purpose of obtaining a Supply of Water for the said Parish.

Specification and Schedule of proposed works may be obtained from the Engineer, Mr. E. H. BRIGHT, Dodds Hall, Braintree.

The Council do not bind themselves to accept the lowest or any Tender.

Tenders to be marked "Water Supply, Bocking" and delivered to Mr. G. ELGER, Clerk to the Bocking Parish Council, Bradford Street, Bocking, on or before the 30th day of December, 1905.

The accepted Contractor for this work will have to find a guarantee bond for £200 from an office approved by the above Council.

NORTH-EASTERN RAILWAY.—TO CONTRACTORS.

—The Directors are prepared to receive TENDERS for the WORKS required in connection with the RECONSTRUCTION of No. 4 GRAVING DOCK, West Hartlepool. Plans may be seen, and copies of the Specification and Quantities obtained, on personal application only to Mr. T. M. NEWELL, Engineer, Dock Office, Hull, on and after December 13th, 1905. Sealed Tenders, marked "Tender for No. 4 Graving Dock, West Hartlepool," to be delivered at the Secretary's Office, York, not later than 12 noon on Wednesday, January 10th, 1906. The Company do not bind themselves to accept the lowest or any Tender.

York, December 4th 1905. R. F. DUNNELL, Secretary.

NEWPORT (MON.) GAS COMPANY.

The Directors of the Newport (Mon.) Gas Company are prepared to receive TENDERS for the WORKS hereinafter described to be carried out at their Crindau Gasworks, Newport Mon.), viz. :—

Contract No. 1.—Extension of existing Retort House, Raising Walls of Building and Roof, Construction of Siding, and Alteration of existing Sidings.

Contract No. 2.—Construction of Regenerative Retort Settings (Horizontal) of 216 Mouthpieces, with all Mains, Fittings, Stage Floor, Coal-handling Plant, comprising coal breaker, elevator, conveyor, hoppers, wagon-tipping travelling crane, capstans, and motors.

Contract No. 3.—Coke-handling Plant, comprising Telpher system, coke trams, and narrow-gauge railway.

Contract No. 4.—Gas Engines and Plant for Generating and Distributing Power on Works.

Contract No. 5.—A Set of Six Purifiers, with Valves, Connections and Shed.

Drawings and Specifications may be seen on application to Mr. THOMAS CANNING, A.M.Inst.C.E., the Engineer, Gasworks, Mill Street, Newport (Mon.), on and after the 11th day of December, 1905, and copies of the Specification, Schedule, and Form of Tender can be obtained on receipt by the undersigned of Five Guineas, which will be returned when a *bona fide* Tender is received.

Tenders, addressed to the Chairman of the Company, to be lodged with the undersigned on or before Wednesday, January 3rd, 1906, sealed and endorsed as directed under the Specifications for each portion of the works.

The Directors do not bind themselves to accept the lowest or any Tender.

Gas Offices, Mill Street, Newport (Mon.). T. H. HAZELL.
November 30th, 1905. Secretary.

ADMINISTRATIVE COUNTY OF LONDONDERRY.

The County Council of the above-named County invite TENDERS, which must be lodged with me on or before Thursday, January 18th, 1906, for the SUPPLY and DELIVERY of :—

ONE STEAM ROAD ROLLER.
ONE ROAD SLEEPING VAN.
ONE WATER CART.

Specifications for the articles required may be seen, or copies obtained, at the office of the County Surveyor, County Courthouse, Londonderry.

Dated this 8th day of December, 1905.

THOMPSON B. ADAMS,
County Courthouse, Londonderry. Secretary to County Council.

CROMPTON URBAN DISTRICT COUNCIL.

The Crompton Urban District Council solicit Tenders for the following :—

(1) SLUDGE-PRESSING MACHINERY.
(2) GAS ENGINE to give 25 brake horse-power when worked with producer gas, also necessary GAS-PRODUCER PLANT for working same.

The prices in each case to include delivery and erection at Council's Newhey Sewage Works.

Further particulars may be obtained on application to Mr. T. MITCHELL, F.G.S., Sewage Works Superintendent, Shaw.

Tenders, sealed and endorsed "Sludge-pressing Machinery," or "Gas Engine and Producer," as the case may be, must be delivered to me on or before Monday, January 8th, 1906.

Town Hall, Shaw, F. F. GARTSIDE,
December 13th, 1905. Clerk to the Council.

APPOINTMENTS OPEN.

LEIGHTON BUZZARD URBAN DISTRICT COUNCIL.

SURVEYOR AND INSPECTOR OF NUISANCES.

The above Council invite applications for the appointment of Surveyor and Inspector of Nuisances.

The salary will be £130 per annum, payable quarterly.

The person appointed will be required to devote his whole time and attention to the Council's work.

Approved security in the sum of £100 will be required, and the appointment will be terminable by one month's notice on either side.

The appointment as regards the office of Inspector of Nuisances will be subject to the approval of the Local Government Board.

Applications, in candidate's own handwriting, stating age, present occupation, and qualifications, accompanied by copies of not less than three testimonials of recent date (the originals of which must be produced if desired), to be sent to me on or before Wednesday, the 27th inst., endorsed "Surveyor, &c."

Canvassing, directly or indirectly, is prohibited, and will be considered a disqualification.

Dated this 2nd day of December, 1905.

REGINALD F. A. TUTT,
Clerk to the Council.

Council Offices, North Street, Leighton Buzzard.

AN "INSTITUTION OF NAVAL ARCHITECTS" SCHOLARSHIP,

of the annual value of £50, and, subject to certain conditions, tenable for three years, will be OFFERED for COMPETITION by the Council of the above Institution.

Candidates must, at the time of the examination, be students of the Institution, and not less than eighteen or more than twenty-one years of age on March 1st, 1906, and must at that date have been continuously employed for two years upon Naval Architecture or Marine Engineering.

Further particulars and forms of entry and conditions regulating the admission of students, may be obtained from the Secretary, Institution of Naval Architects, 5, Adelphi Terrace, London, W.C.

Applications must be sent in by February 1st, 1906.

CIVIL SERVICE COMMISSION.

FORTHCOMING EXAMINATION.
SECOND-CLASS ENGINEERS, ENGINEER-IN-CHIEF'S DEPARTMENT, GENERAL POST OFFICE (22-24).
JANUARY 11TH, 1906.

The date specified is the latest at which applications can be received. They must be made on forms to be obtained, with particulars, from the Secretary, Civil Service Commission, Burlington Gardens, London, W.

NOTICE TO MARINE ENGINEERS.

The Arklow Harbour Commissioners require the SERVICES of an ENGINEER to prepare plans for the Extension of the South Breakwater, and to superintend the carrying out of same. Such plans to meet the approval of the Harbour Commissioners and the sanction of the Lord-Lieutenant.

Parties applying for the position must satisfy the Board that their appointment will have the approval of the Lord-Lieutenant.

Applications to be sent, stating fees, &c., to the Secretary, Harbour Commissioners, before January 9th, 1906.

CITY OF AUCKLAND, NEW ZEALAND.

APPOINTMENT OF CITY ENGINEER.

Applications, accompanied by Testimonials, will be received in the Town Clerk's Office, Auckland, New Zealand, until 4 o'clock p.m. on Thursday, February 8th, 1906, for the appointment of City Engineer to the City of Auckland. Conditions of appointment may be seen, and copies obtained, at the office of the High Commissioner for New Zealand, Westminster Chambers, 13, Victoria Street, London, S.W.

HENRY W. WILSON,
September 1st, 1905. Town Clerk.

BUYERS' DIRECTORY.

NOTE.—*The display advertisements of the firms mentioned under each heading can be found readily by reference to the Alphabetical Index to Advertisers on pages* 35, 37, 38, *and* 40.

In order to assure fair treatment to advertisers, each firm is indexed under its leading speciality ONLY.

Advertisers who prefer, however, to be entered under two or more different sections can do so by an annual payment of 5s. *for each additional section.*

Advertisers' Service Bureau.
British Advertiser Service Bureau, Queen Anne's Chambers Westminster, S.W.

Artesian Well Machinery.
John Z. Thom, Patricroft, Manchester.

Band Sawing Machines.
Noble & Lund, Ltd., Felling-on-Tyne.

Bearings (Roller).
Hyatt Roller Bearing Co., 47, Victoria Street, London, S.W.

Belting.
Binney & Son, Catherine Street, City Road, London, E.C.
Cort, Arthur, & Co., Camberwell, London, S.E.
Fleming, Birkby & Goodall, Ltd., West Grove, Halifax.
Gilmour, W. & O., St. John's Hill, Edinburgh.

Boilers.
Clayton, Son & Co., Ltd., Leeds City Boiler Works, Leeds.
Grantham Boiler and Crank Co., Ltd., Grantham.
Hartley & Sugden, Ltd., Halifax.
Thompson, John, Wolverhampton.

Boilers (Water-tube).
Babcock & Wilcox, Ltd., Oriel House, Farringdon Street, London, E.C.
Stirling Boiler Co., Ltd., Motherwell, N.B.

Bolts, Nuts, Rivets, etc.
Herbert W. Periam, Ltd., Floodgate Street Works, Birmingham.
T. D. Robinson & Co., Ltd., Derby.

Books.
Griffin, Charles, & Co., Exeter Street, Strand, W.C.
New Zealand Mines Record, Wellington, New Zealand.
Spon, E. & F. N., 125, Strand, W.C.

Boring Machines.
Asquith, William, Ltd., Well Road Works, Halifax.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne.

Cables.
Callender's Cable and Construction Co., Ltd.

Case-Hardening Compounds.
Hy. Miller & Co., Millgarth Works, Leeds.

Castings.
Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees.

Catalogues, Printing, &c.
Atlantic Press, Ltd., Weymouth Street, Manchester.
Spottiswoode Advertising Agency, Clun House, Surrey Street, Strand, W.C.
Stafford, Arthur, & Co., Denton, Manchester.

Chucks.
Fairbanks Co., 78-80, City Road, London, E.C.

Cisterns, Tanks, &c.
Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees.
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Clutches (Friction).
David Bridge & Co., Castleton Ironworks, Rochdale, Lancashire.

Coke Oven Expert.
Mallmann, P. J., 110-118, Victoria Street, S.W.

Condensing Plant.
Benn, Sykes, Haslingden, near Manchester.
Concentric Condenser, Ltd., 23, Northumberland Avenue, London, W.C.
Mirrlees-Watson & Co., Ltd., Glasgow.

Consulting Engineers.
Gibbs, John, & Son, 80, Juke Street, Liverpool.
G. H. Hughes, A.M.I.M.E., 19, Old Queen Street, Westminster, S.W.
Melville & Macalpine, 615, Walnut Street, Philadelphia, Pa., U.S.A.
Mount-Haes, A., M.I.Mech.E., M.I.M.E., 11, Ironmonger Lane, London, E.C.

Continental Railway Arrangements.
Northern Railway of France.
South Eastern & Chatham Railway Co.

Conveying and Elevating Machinery.
Adolf Bleichert & Co., Leipzig-Gohlis, Germany.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
Temperley Transporter Co., 72, Bishopsgate Street Within, London, E.C.

Copper and Brass.
W. Hepton & Son, Hunslet Lane, Leeds.

Coverings (Boiler).
Magnesia Covering Ltd., Washington Station, co. Durham.

Cranes, Travellers, Winches, etc.
Joseph Booth & Bros. Ltd, Rodley, Leeds.
Thomas Broadbent & Sons, Ltd., Huddersfield.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

Cranks.
Clarke's Crank & Forge Co., Ltd., Lincoln, England.

Cutters (Milling).
Pratt & Whitney Co., 23-25, Victoria Street, London, S.W.
E. G. Wrigley & Co., Ltd., Foundry Lane Works, Soho, Birmingham

Destructors.
Heenan & Froude, 4, Chapel Walks, Manchester.
Horsfall Destructor Co., Ltd., Armley, Leeds.

Dredges and Excavators.
Delange & Cie, Mce., Hoboken, near Antwerp.
Rose, Downs & Thompson, Ltd., Old Foundry, Hull.

Drilling Machines.
Asquith, William, Ltd., Well Road Works, Halifax.
Niles-Bement-Pond Co., 23-25, Victoria Street London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne
Swift, George, Clarence Ironworks, Halifax.

Economisers.
E. Green & Son, Ltd., Manchester.

Ejectors (Pneumatic).
Hughes & Lancaster, 16, Victoria Street, London, S.W.

Electrical Apparatus.
Allgemeine Elektricitäts Gesellschaft, Berlin, Germany.
British Westinghouse Electric and Manufacturing Co., Ltd., Norfolk Street, Strand, London, W.C.
Broadbent, T. W., Victoria Electrical Works, Huddersfield.
Crypto Electrical Co., 3, Tyer's Gateway, Bermondsey Street, London, S.E.
Ebonestos Manufacturing Co., 22, Rosoman Street, London, E.C.
Gent & Co., Ltd., Faraday Works, Leicester.
Greenwood & Batley, Ltd., Albion Works, Leeds.
India Rubber, Gutta Percha, and Telegraph Works Co., Ltd., Silvertown, London, E.
Matthews & Yates, Ltd., Swinton, Manchester.
Mix and Genest, Berlin, W., Germany.
Nalder Bros. & Thompson, 34, Queen Street, London, E.C.
New Gutta Percha Co., Ltd., Dashwood House, New Broad Street, E.C.
Newton Brothers, Full Street, Derby.
Phœnix Dynamo Manufacturing Co., Bradford, Yorks.
Scott, E., & Mountain, Ltd., Newcastle-on-Tyne.
Sturtevant Engineering Co., Ltd., 147, Queen Victoria Street, London, E.C.
Turner, Atherton & Co., Ltd., Denton, Manchester.
B. Weaver & Co. (*see* Ebonestos Manufacturing Co.), 22, Rosoman Street, Clerkenwell, London, E.C.

Engineers' Supplies.
Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.

Engines (Gas).
Campbell Gas Engine Co., Ltd., Halifax.
Cundall, Son & Co., Ltd., Airedale Iron Works, Shipley.

Engines (Electric Lighting).
McLaren, J. and H., Midland Engine Works, Leeds.

Engines (Locomotive).
Baldwin Locomotive Works, Philadelphia, Pa., U.S.A.
Hunslet Engine Co., Ltd., Leeds, England.
Hudswell, Clarke & Co., Ltd., Leeds, England.
McLaren, J. & H., Midland Engine Works, Leeds.

Engines (Stationary).
Allis-Chalmers Co., 533, Salisbury House, Finsbury Circus, London, E.C.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
Mirrlees Watson Co., Ltd., Glasgow.

Engines (Traction).
Jno. Fowler & Co. (Leeds), Ltd., Steam Plough Works, Leeds.

Engravers.
Jno. Swain & Son, Ltd., 58, Farringdon Street, London, E.C.

Exhaust Steam Oil Separators.
Lancaster & Tonge, Ltd., Pendleton, Manchester.

Fans, Blowers.
Capel Fan Co., 13, Moseley Street, Newcastle-on-Tyne.
Davidson & Co., Ltd., "Sirocco" Engineering Works, Belfast Ireland.
Gibbs, John & Son, 80, Juke Street, Liverpool.
Matthews & Yates, Ltd., Swinton, Manchester.

Files.
Flockton, Tompkin & Co., Ltd., Newhall Steel Works, Sheffield.

Fire Bricks.
J. H. Sankey & Son, Ltd., Essex Wharf, Canning Town, London, E

PAGE'S WEEKLY Testing Machines

Buyers' Directory—(*Continued*).

Firewood Machinery.
M. Glover & Co., Patentees and Saw Mill Engineers, Leeds.

Fountain Pens.
Mabie, Todd & Bard, 93, Cheapside, London E.C.

Forging (Drop) Plants.
Brett's Patent Lifter Co., Ltd., Coventry.

Forgings (Drop).
J. H. Williams & Co., Brooklyn, New York, U.S.A.

Furnaces.
Deighton's Patent Flue & Tube Company, Vulcan Works, Pepper Road, Leeds.
Leeds Forge Co., Ltd., Leeds.

Gauge Glasses.
J. B. Treasure & Co., Vauxhall Road, Liverpool.
Tomey, J., & Sons, Aston, Birmingham.

Gauges (Pressure, Vacuum, and Hydraulic).
Dobbie, McInnes, Ltd., 45, Bothwell Street, Glasgow.

Gearing.
Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.
Angus, G. & Co., Ltd., Newcastle-on-Tyne.
Asquith, William, Ltd., Well Road Works, Halifax.
Reid Gear Co., Linwood, near Glasgow.
Wild, M. B., & Co., Corporation Street, Birmingham.

Gold Dredging Plant.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.

Greases.
Blumann and Stern, Ltd., Plough Bridge, Deptford, London, S.E.

Hack Saws.
Baynes, Charles, Knuzden Brook, Blackburn.

Hammers (Steam).
Davis & Primrose, Leith Ironworks, Edinburgh.
Niles-Bement Pond Co., 23-25, Victoria Street, London, S.W.

Hoisting Machinery.
See Conveying Machinery.

Horizontal Boring Machines.
Asquith, William, Ltd., Well Road Works, Halifax.
Greenwood & Batley, Albion Works, Leeds.
Niles-Bement Pond Co., 23-25, Victoria Street London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne.
Swift, George, Clarence Ironworks, Halifax.

Hydraulic Leather.
Ahlers, Ad., Whitley Bay, near Newcastle-on-Tyne.

Hydraulic Machine Tools.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Vauxhall and West Hydraulic Engineering Co. Ltd., 23, College Hill, London, E.C.

Icemaking and Refrigerating Machinery.
H. J. West & Co., 114-118, Southwark Bridge Road, London, S.E.

Indicators.
Dobbie McInnes, Ltd., 45, Bothwell Street, Glasgow.
Hannan & Buchanan, 75, Robertson Street, Glasgow.

Iron and Steel.
Allen, Edgar, & Co. Ltd., Imperial Steel Works, Sheffield.
Askham Bros. & Wilson, Ltd., Sheffield.
Buckley, Saml., St. Paul's Square, Birmingham.
Fairley & Sons, James, Old Mint, Shadwell Street, Birmingham.
Farnley Iron Co., Ltd., Leeds, England.
Flockton, Tompkin & Co., Ltd., Newhall Steel Works, Sheffield.
Fried. Krupp, Grusonwerk, Magdeburg-Buckau, Germany.
J. Frederick Melling, 14, Park Row, Leeds, England.
Parker Foundry Co., Derby.
Purden, John & Sons, Lambhill Forge, by Maryhill, Glasgow.
Walter Scott, Ltd., Leeds Steel Works, Leeds, England.

Ironwork (Constructional).
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Ironwork (Galvanised).
F. A. Keep, Juxon & Co., Barn Street, Birmingham.

Lagging Sheets.
Zeitz & Co., 21, Lime Street, London, E.C.

Lathes.
Asquith, William, Ltd., Well Road Works, Halifax.
Bradbury & Co., Ltd., Wellington Works, Oldham.
Eclipse Tool Manufacturing Co., Linwood, near Glasgow.
Leckenby, Benton, & Co., Perseverance Ironworks, Halifax.
Mitchell, D., & Co., Ltd., Parsonage Works, Keighley.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne.
Northern Engineering Co. (1900), Ltd., King Cross, near Halifax.
Swift, George, Clarence Ironworks, Halifax.

Lathe Carriers
Williams, J. H., & Co., Brooklyn New York, U.S.A.

Laundry Machinery.
W. Summerscales & Sons, Ltd., Engineers, Phœnix Foundry, Keighley, England.

Lifts.
Waygood & Co., Ltd., Falmouth Road, London, S.E.

Lubricants.
Blumann & Stern, Ltd., Plough Bridge, Deptford, London, S.E.
Reliance Lubricating Oil Co., The, 19 & 20, Water Lane, Great Tower Street, London, E.C.
Matthew Wells & Co., Hardman Street Oil Works, Manchester.

Machine Tools.
Asquith, William, Ltd., Well Road Works, Halifax.
George Addy & Co., Waverley Works, Sheffield.
Bateman's Machine Tool Co., Hunslet, Leeds.
Beanland, Perkin, & Co., School Close Works, Leeds.
Bertrams, Ltd., St. Katherine's Works, Sciennes, Edinburgh.
Bradbury & Co., Ltd., Wellington Works, Oldham.
Breuer, Schumacher & Co., Ltd., Kalk, near Cologne-on-Rhine (Germany).
Consolidated Pneumatic Tool Co., Ltd., Palace Chambers, 9, Bridge Street, Westminster, S.W.
Cunliffe & Croom, Ltd., Broughton Ironworks, Manchester.
Dean, Smith & Grace, Ltd., Keighley.
Dempster, Moore & Co., Ltd., 49, Robertson Street, Glasgow.
Fengl, A., & Co., Grafton Street, Altrincham.
Greenwood & Batley, Ltd., Leeds.
Jones & Lamson Machine Co., 97, Queen Victoria Street, London, E.C.
John Lang & Sons, Johnstone, near Glasgow.
Luke & Spencer, Ltd., Broadheath, Manchester.
Jos. C. Nicholson Tool Co., City Rd. Tool Wks., Newcastle-on-Tyne.
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne.
Northern Engineering Co., 1900, Ltd., King Cross, near Halifax.
J. Parkinson & Son, Canal Ironworks, Shipley, Yorkshire.
C. Redman & Sons, Halifax.
Resides, 12, Aire Street, Brighouse, Yorks.
Rice & Co. (Leeds), Ltd., Leeds, England.
G. F. Smith, Ltd., South Parade, Halifax.
Swift, George, Clarence Ironworks, Halifax.
Taylor and Challen, Ltd., Derwent Foundry, Constitution Hill, Birmingham.
Vauxhall and West Hydraulic Engineering Co., Ltd., 23, College Hill, London, E.C.
H. W. Ward & Co., Lionel Street, Birmingham.
T. W. Ward, Albion Works, Sheffield.
West Hydraulic Engineering Co. (see Vauxhall and West Hydraulic Engineering Co. Ltd.), 23, College Hill, London, E.C.
Winn, Charles, & Co., St. Thomas Works, Birmingham.
Yorkshire Machine Tool and Engineering Works, Liversedge, Yorks.

Marks.
Pryor, Edward, & Son, 68, West Street, Sheffield.

Metals.
Delta Metal Co., Ltd., East Greenwich, London, S.E.
Magnolia Anti-Friction Metal Co., Ltd., of Great Britain, 49, Queen Victoria Street, London, E.C.
Phosphor Bronze Co., Ltd., Southwark, London, S.E.

Metals (Perforated).
W. Barns & Son, Chalton Street, Euston Road, London, N.W.
Brown, Andrew, & Co., 110, Cannon Street, London, E.C.
Méguin, Fr., & Co., Ltd., Engineering Works, Dillingen-on-Saar.

Mining Drill Steel.
Flockton, Tompkin & Co., Ltd., Newhall Steel Works, Sheffield.

Mining Machinery.
Fraser & Chalmers, Ltd., 3 London Wall Buildings, London, E.C.

Office Appliances.
Davis John, & Son, Ltd., 30, All Saints' Works, Derby.
Halden & Co., J., 8, Albert Square, Manchester.
Hall & Co., B. J., 39, Victoria Street, London, S.W.
Inglesant, T., & Sons, Ltd., Atlas House, Leicester.
Lyle Co., Ltd., Harrison Street, Gray's Inn Road, London, W.C.
Rookwell-Wabash Co. Ltd., 69, Milton Street, London, E.C.
Shannon, Ltd., Ropemaker Street, London, E.C.
Trading and Manufacturing Co., Ltd., Temple Bar House, Fleet Street, London, E.C.

Oils, &c.
Blumann and Stern, Ltd., Plough Bridge, Deptford, London, S.E.
Wells, M., & Co., Hardman Street Oil Works, Manchester.

Oil Filters and Cabinets.
Valor Co., Ltd., Rocky Lane, Aston Cross, Birmingham.

Packing.
Beldam Packing & Rubber Co., 93-94, Gracechurch Street, London, E.C.
Lancaster & Tonge, Ltd., Pendleton, Manchester.
Redfern & Co., S., Swan Lane, New Brown Street, Manchester.
Quaker City Rubber Co., Coronation House, Lloyd's Avenue, E.C.
United States Metallic Packing Co., Ltd., Bradford.
J. Bennett von der Heyde, 6, Brown Street, Manchester.

Paper.
Lepard & Smiths, Ltd., 29, King Street, Covent Garden, London, W.C.

PAGE'S WEEKLY Pumping Machinery

Buyers' Directory—(*Continued*).

Photo Copying Frames.

J. Halden & Co., 8, Albert Square, Manchester
B. J. Hall & Co., 39, Victoria Street, London, S.W.

Photographic Apparatus.

Marion & Co., Ltd., 22 and 23, Soho Square London, W.

Pinch Bars.

Samson & Co., Garforth, near Leeds.

Pipe Wrenches (Chain).

Williams, J. H., & Co., Brooklyn, New York, U.S.A.

Pistons.

Lancaster & Tonge, Ltd., Pendleton, Manchester.

Planished Sheets.

Zeitz & Co., 21, Lime Street, London E.C.

Pneumatic Tools.

Consolidated Pneumatic Tool Co., Ltd., Palace Chambers, 9, Bridge Street, Westminster, S.W.

Porcelain.

Gustav Richter, Charlottenburg, near Berlin, Germany.

Presses (Hydraulic).

Greenwood & Batley, Albion Works, Leeds
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.

Publishers.

Charles Griffin & Co., Ltd., Exeter Street, Strand, London, W.C.
Spon, E. and F. N., 125, Strand, W.C.
New Zealand Mines Record, Wellington, New Zealand.

Pumps and Pumping Machinery.

Drum Engineering Co., 33, Brook Street, Bradford.
Enke, Carl, Schkeuditz-Leipzig, Germany.
Fraser & Chalmers, Ltd., 3, London Wall Buildings, London, E.C.
J. P. Hall & Sons, Ltd., Peterborough.
Hathorn, Davey & Co., Ltd., Leeds, England.
Positive Rotary Pumps, Ltd., 23, Northumberland Avenue, London, W.C.

Radial Drilling Machines.

Asquith, William, Ltd., Well Road Works, Halifax.
Greenwood & Batley, Albion Works, Leeds
Mitchell, D. & Co. Ltd. Parsonage Works, [illegible]
Niles-Bement-Pond Co., 23-25, Victoria Street, London, S.W.
Noble & Lund, Ltd., Felling-on-Tyne
Northern Engineering Co. (1900), Ltd., King Cross, near Halifax
Swift, George, Clarence Ironworks, Halifax.

Rails.

Wm. Firth, Ltd., Leeds.

Riveted Work.

F. A. Keep Juxon & Co., Forward Works, Barn Street, Birmingham.

Roller Bearings.

Hyatt Roller Bearing Co., 47, Victoria Street, London, S.W.

Roofs.

D. Anderson & Son Ltd., Lagan Felt Works, Belfast
Head, W[illegible] & Co., Ltd., Thornaby-on-Tees
McTear & Co., Ltd., Newtownards Road, Belfast.

Ropeways (Aerial).

[illegible] & [illegible] Ltd., [illegible] Lane, London, [illegible]
Pohlig, J., Ltd., Cologne, Germany.

Scientific Instruments.

Cambridge Scientific Instrument Co., Ltd. Cambridge.

Slotting Machines.

[illegible], George, [illegible]

Spanners.

[illegible] U.S.A.

Stampings.

Thomas Smith & Sons of Saltley, Ltd., Birmingham.
Williams, J. H., & Co., Brooklyn, New York, U.S.A.

Stamps (Rubber).

Rubber Stamp Co., 1 & 2, Holborn Buildings, Broad Street Corner, Birmingham.

Stamps (Metal).

Edward Pryor & Son, 68, West Street, Sheffield.

Steam Traps.

Lancaster & Tonge, Ltd., Pendleton, Manchester.

Steam Wagons.

Thornycroft & Co., Ltd., J. I., Chiswick, London, W.
Yorkshire Patent Steam Wagon Co., Pepper Road, Hunslet, Leeds.

Steel Structures.

Ashmore, Benson, Pease & Co., Ltd., Stockton-on-Tees.

Steel Tools.

Saml Buckley, St. Paul's Square, Birmingham.
Pratt & Whitney Co., 23-25, Victoria Street, London, S.W.

Steel (Tool Steel).

Flockton, Tompkin & Co., Ltd, Newhall Steel Works, Sheffield.

Stokers.

Ed. Bennis & Co., Ltd., Bolton, Lancs.

Stone Breakers.

S. Pegg & Son, Alexander Street, Leicester.

Superheaters.

A. Bolton & Co., [illegible] Deansgate, Manchester

Time Recorders.

Howard Bros., 40, Paradise Street, Liverpool, and 100b, Queen Victoria Street, London, E.C.

Tubes.

Thomas Piggott & Co. Ltd., Spring Hill, Birmingham
Tubes, Ltd., Birmingham.

Turbines.

Greenwood & Batley, Albion Works, Leeds.
S. Howes Co., 64, Mark Lane, London, E.C.

Typewriters.

Empire Typewriter Co., 77, Queen Victoria Street, London, E.C.
Yost Typewriter Co., 50, Holborn Viaduct, London, E.C.

Valves.

Holmes & Co., W. C., Huddersfield.
Hopkinson, J. & Co., Ltd., Britannia Works, Huddersfield.
Hunt & Mitton, Crown Brass Works, [illegible] Street North, Birmingham.
Scotch and Irish Oxygen Co., Ltd., Rosehill Works, Glasgow.
Shaw, Joseph, Albert Works, Huddersfield.
Winn, Charles, & Co., St. Thomas Works, Birmingham.

Ventilating Appliances.

Matthews & Yates, Ltd., Swinton, Manchester.

Water Softeners and Purifiers.

[illegible] & [illegible] Queen Victoria Street, London, E.C.

Wagons—Steam.

Thornycroft & Co., J. I., Ltd., Chiswick, London, W.

Weighing Apparatus.

W. & T. Avery, Ltd., Soho Foundry, Birmingham, England
Samuel Denison & Son, Hunslet Moor, near Leeds

Wells Light.

A. C. Wells & Co., 100A, Midland Road, St. Pancras, London, N.W.

Wire Working Machinery.

Ed. Brand, 35, Shakespeare Street, Manchester.

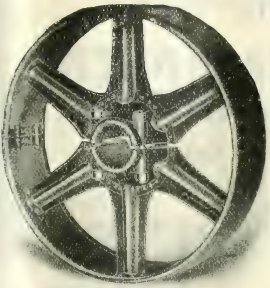
"Woodite."

Woodite Company, Mitcham, Surrey.

PAGE'S WEEKLY — Miscellaneous

FAIRBANK'S

All Wrought Steel Split Pulleys



WITH INTERCHANGEABLE BUSHING SYSTEM.

The All Wrought Steel Split Pulley is the strongest yet lightest metal pulley ever put on the market. It is as light as the Wood Pulley and stronger than any extra heavy cast iron pulley, and one-third the weight, taking less power to drive it, having perfect balance, stiffness, and resistance to centrifrugal forces.

The steel used in the construction of this Pulley is not of "soft drawn stock," as is generally supposed, but it is a special steel that is made for this particular Pulley. It being very tough homogeneous steel; being pliable, yet resilient, thereby giving the maximum strength obtained in any steel.

Fairbanks-Pardee Steel Shafting.

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GLASGOW OFFICE: 54-56, Bothwell Street.

"CAMPBELL"

GAS ENGINES & SUCTION PLANTS, OIL ENGINES & PUMPS.

SOLE MAKERS—

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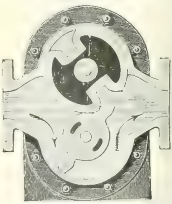
Halifax, England.

London Office— **114, Tooley Street, S.E.**

Glasgow Office— **104, Bath Street.**



Section of "Drum" Pump.

THE...

"DRUM" PUMP.

JOHNSON'S PATENTS.

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POSITIVE ACTION.
NO VALVES.
HIGH EFFICIENCY.

DRUM ENGINEERING CO.,
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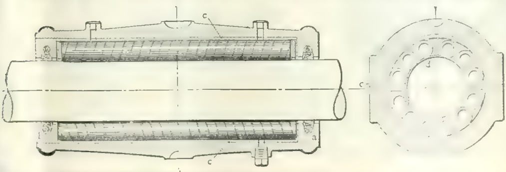
BRADFORD.

HYATT ROLLER BEARING CO.

The **HYATT FLEXIBLE ROLLER BEARINGS,** as applied to Shafting and General Power Transmission Machinery, will save **50** to **75** per cent. of the Frictional Load. Efficiency and Durability Guaranteed. Goods sent on approval. Returnable if not satisfactory.



Section of Steel Shaft Box. Hyatt Flexible Roller Bearing.

For new descriptive Book write to

HYATT ROLLER BEARING CO.,
47, Victoria St.,
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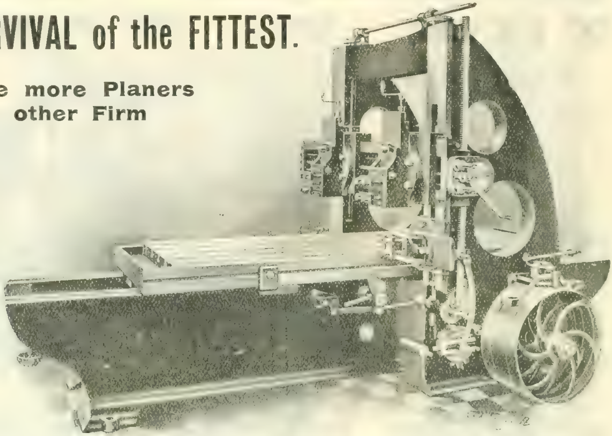
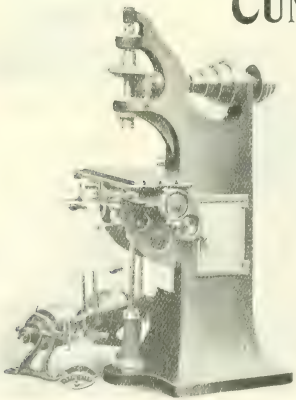
PAGE'S WEEKLY — Machine Tools

PAGE'S WEEKLY — Machine Tools

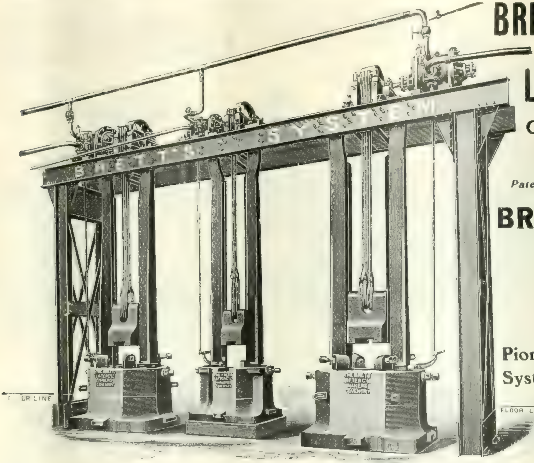




A Size Vertical Milling Machines.

PAGE'S WEEKLY Machine Tools

PAGE'S WEEKLY — Machine Tools



BRETT'S PATENT LIFTER Co. Ltd.,

Coventry, England.

Patentees and Manufacturers o

BRETT'S PATENT LIFTERS, ETC.

Pioneers of the Modern System of Drop Forging.

Telegraphic Address :
"LIFTER, COVENTRY."
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Dean, Smith, & Grace, LTD.,

Lathe Manufacturers,

Established 1865.

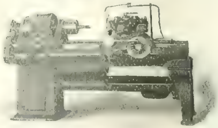
KEIGHLEY.

WRITE FOR CATALOGUE.

See Our Advertisement next Week.

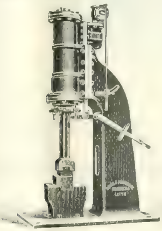
TURRET LATHES.

BRITISH MAKE THROUGHOUT.



See our page Advertisement next week

THE ECLIPSE TOOL MANUFACTURING CO.,
LINWOOD, near GLASGOW.



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FOR SMITHS' SHOPS AND FORGES.

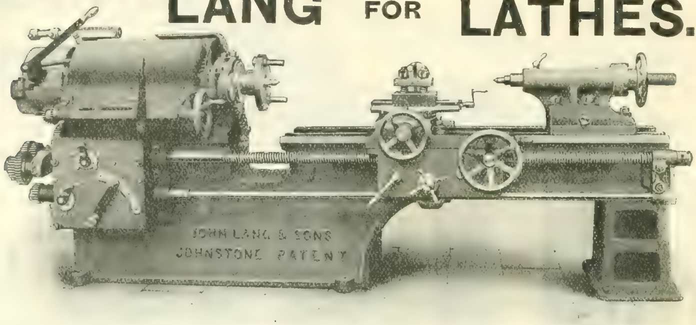
Patent Bevelling Machines for Ships' Frames.

DAVIS & PRIMROSE,

Leith Ironworks, **EDINBURGH.**

PAGE'S WEEKLY Machine Tools

LANG FOR LATHES.



Patent Variable Speed Drive Patent Bed—Patent Screw Cutting and Feed Motions—Patent Loosehead.

ASK FOR YELLOW BOOKLET, OR VISIT OUR WORKS.

JOHN LANG & SONS, Johnstone, near Glasgow.

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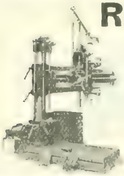


Write for our Lists.

D. MITCHELL & CO., Ltd.,

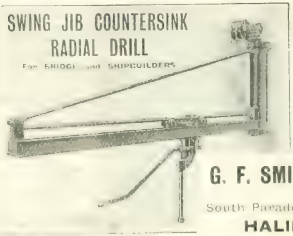
Parsonage Works, KEICHLEY.

[illegible] "TOOLS," [illegible]

On War Office and India Office Lists.

SWING JIB COUNTERSINK RADIAL DRILL

For BRIDGE and SHIPBUILDERS



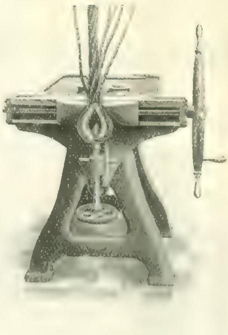
MACHINE TOOLS.

[illegible]

G. F. SMITH, Ltd.,

South Parade,

HALIFAX.



Cable Bending and Splicing Vise.

[illegible]

J. PARKINSON & SON,

SHIPLEY, ENGLAND.

[illegible] TEMPLES, SHIPLEY [illegible] Code [illegible]

PAGE'S WEEKLY Machine Tools

COUNT THE CYCLES.

THIS is more accurate than gauging the efficiency of your planers by **maximum speeds only,** because of the time lost on reversing. The time of a cycle (the complete "cut" and "return" journey) includes the loss due to acceleration at both **ends** of the stroke.

The High-Speed Planer illustrated completes **10 cycles in 4 minutes** when on a 12 ft. stroke.

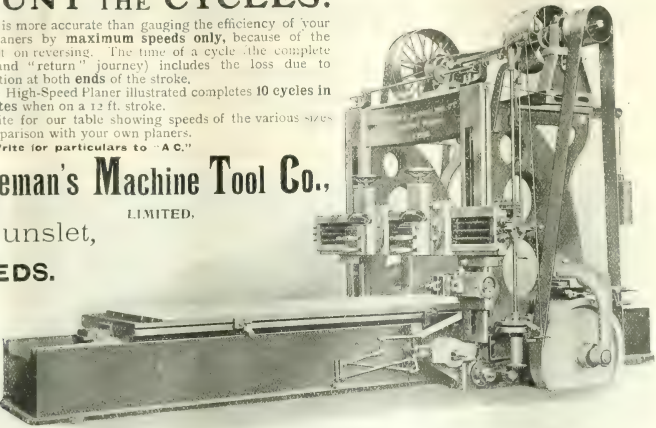
Write for our table showing speeds of the various sizes for comparison with your own planers.

Write for particulars to "A C."

Bateman's Machine Tool Co.,
LIMITED,

Hunslet,

LEEDS.

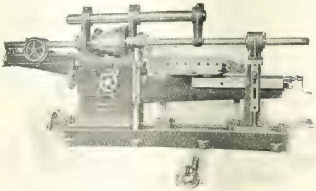


60 in by 60 in. by 12 ft. Patent High-Speed Planer, cutting 40 ft p.m., returning 140 ft. p.m.

POWERFUL, DURABLE, ACCURATE.

These are essential qualifications in machines of the type illustrated. Our make complies with these requirements, and in addition embodies all the most advanced time and labour saving features.

COMBINED HORIZONTAL DRILLING, BORING, FACING, AND MILLING MACHINES . . .



Large range of speeds and feeds.
Tables self-acting in all traverses.
Strong and rigid for high speeds
Cover a very large range, and various classes of work.

Send for descriptive Booklet, BI.

CONTRACTORS to the ADMIRALTY, WAR OFFICE, Etc.

WILLIAM ASQUITH, LTD.,

SPECIALISTS in HIGH-SPEED DRILLING and BORING MACHINES.

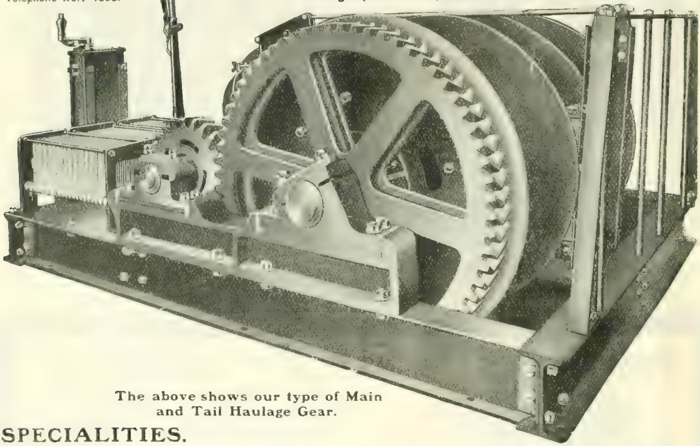
Well Road Works, HALIFAX, England.

PAGE'S WEEKLY Mining Machinery

ELECTRIC MINING MACHINERY.

Send us Particulars of your requirements, or Sketch of your Workings, when we will submit to you the most Economical Method and our Lowest Prices.

Telephone No.: 4608. Telegrams: "HAULING, BIRMINGHAM."



The above shows our type of Main and Tail Haulage Gear.

SPECIALITIES.

Our Specialities are: Secondary Haulage, Electrically Driven Three-throw Pumps, Main and Tail, Main Rope, Endless Rope, and Portable Hoisting and Hauling Gears.

M. B. WILD & CO.,

Mechanical and Electrical Engineers.

Head Offices:—

35 & 36, Clarence Chambers, Corporation Street,

BIRMINGHAM.

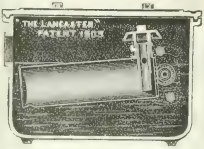
Works NECHELLS, BIRMINGHAM.

PAGE'S WEEKLY — Steelwork, &c.

PAGE'S WEEKLY — Steam Traps, &c.

"The Lancaster" (R.T.M.)

STEAM TRAPS.



These Traps, besides being economical, efficient, and reliable, can be opened and examined while working.

By means of our patent Dirt Arrester, dirt is prevented from entering the trap, and thus a frequent source of steam trap failures is avoided. Write for Catalogue C.

FIRST ORDERS SENT ON APPROVAL.

LANCASTER & TONGE, Ltd., PENDLETON, MANCHESTER.

"THE LANCASTER" PISTONS, METALLIC PACKINGS, STEAM DRYERS, SPIRAL SPRINGS, etc.

MONEY IN IT

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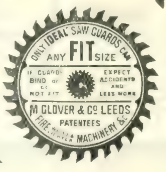

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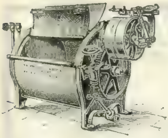
PAGE'S WEEKLY Miscellaneous



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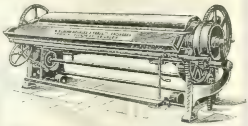

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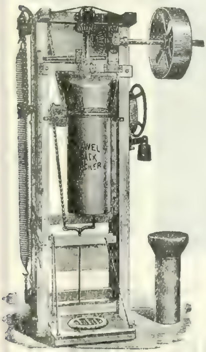

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PAGE'S WEEKLY — Miscellaneous

Index to Advertisers.

Advertisements not appearing this week will be found by reference to the preceding or following issues, with the exception of those appearing monthly.

* See next issue.

PAGE'S WEEKLY Electrical Apparatus, &c.

Index to Advertisers—(Contd.)

Index to Advertisers—(Contd.)

PAGE'S WEEKLY Miscellaneous

Index to Advertisers—(Contd.)

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PAGE'S WEEKLY Miscellaneous

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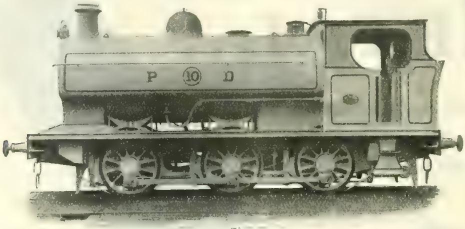

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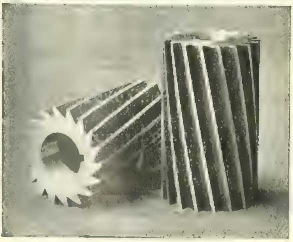

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PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

Vol. VII. LONDON, FRIDAY, DECEMBER 22, 1905. No. 175.

The Offices of "Page's Weekly," Wednesday Evening.

SIR WILLIAM MATHER, in delivering the prizes at the Municipal Institute at Belfast the other day, gave some wise counsel to all interested in the subject of technical education. He put it to employers whether they would not prefer their workpeople using intelligence and showing the exercise of the brain in all their work. If the sense of drudgery were excluded from any occupation it became an efficient power for service. The highest wages were paid to the man whose brain power would enable the largest number of other men to be most profitably employed. His experience was that it was absolutely necessary for all employers to encourage the practical training of boys and youths now given in technical institutes if they had the patriotism to desire that their country should stand in the front rank for scientific industry.

He put it in another way. The arrangement of workshops and manufactories of all kinds, the use of complicated labour-saving tools, the methods of precision and accuracy now taking the place of rough-and-ready guess work in construction, in order to economise material and workmanship—the whole tendency of shop management was to require trained intelligence all through, from the labourer according to his labour, to the manager, who controlled all. Though the workman did his work within the power and reach of his arm, he might direct the arm by the brain, so that every movement should be effective, just as the manager, whose brain must direct through a radius far beyond the workman's arm, would be much more efficient if the brain power was thoroughly trained to direct the work of others in the most profitable manner. The enormous

Photo. [illegible]

SIR WILLIAM MATHER, LL.D., M.INST.C.E.

THE ST. LAWRENCE RIVER BRIDGE AS IT WILL APPEAR.
River span, 1,800 ft. Two anchor spans, 500 ft. Two shore spans, 214 ft. Total length, 3,228 ft.

potentiality in the cultivated brains of a whole people could not be measured. It meant infinite progress, materially and morally.

He then referred to the thoroughness and intensity of purpose which influenced workers in America, and gave some typical instances of earnest ambition towards educational thoroughness. Sir William Mather then asked what was to become of the nation which was training its youth, not by hundreds, but by thousands scientifically in connection with its industries; and what, on the other hand, would become of the country in which they were only being trained in twos, threes, or tens?

In a lecture on mining in ancient and modern times, delivered recently before the Chartered Institute of Secretaries, Mr. Bennett H. Brough explained some of the mining appliances that are now used and that were used in early days. He traced the improvements in methods and machines, which have rendered it possible to mine with profit copper ore in the Lake Superior district at a depth of 5,000 ft., gold ore at the New Chum Railway Mine in Victoria at a depth of 4,226 ft., and coal at the Pendleton Mine, near Manchester, at a depth of 3,500 ft., to work with profit at Kimberley rock yielding one-tenth of a carat of diamonds per load, or, when only one-hundred millioneth of the stuff coming out of the mines is diamonds, to work with profit at the Atlantic Mine, Lake Superior, rock containing seven-tenths of ore per cent. of copper, and for a gold mine at Bendigo to pay a dividend on a yield of 2 dwt. to the ton of ore.

The illustration on page 1359, is, we believe, the latest photograph as yet published, showing the work in progress on the new St. Lawrence River Bridge—a structure which will take a prominent place among the world's great bridges. Apart from the collossal dimensions of the structure, it will form a very important link in the projected Grand Trunk Pacific trans-continental railway. From the drawing above, which gives an idea of the final appearance of the bridge, it will be seen that it is of cantilever construction. The river at this point—about six miles above the City of Quebec—narrows down to less than 2,000 ft. at low water, and above this there is no other crossing for 165 miles.

The central span of the bridge, extending almost from bank to bank of the river, is 1,800 ft. long from centre to centre of piers. The central suspended girder, 675 ft. long and 130 ft. deep at middle, will be connected to cantilever arms 526 ft. 6 in. long, the anchor spans being each 500 ft., and the approach spans 214 ft. in length. The bridge will carry two lines of railway, two trolley lines, two highways, and two side walks. The latter are carried on the outside of the trusses by cantilever extensions of the cross girders. The balance of the traffic will be carried between the trusses, which are placed 67 ft. apart. The photograph shows the falsework for the erection of the south anchor. The 105-ton steel traveller shown is 215 ft. high. It is 100 ft. wide at the base and has an over-reach of 66 ft. The Canadian winter will probably

necessitate a suspension of the work until April. The bridge is being built for the Quebec Bridge and Railway Company by the Phœnix Bridge Company, to whom we are indebted for the photo.

Reference was made in the last issue of this journal to the opening of the Conference on Smoke Abatement, and the really national character of the problems to be there discussed. The opening address of Sir Oliver Lodge insisted on the need for improved methods of burning fuel, both for domestic and manufacturing purposes, and this is the problem which in its many aspects has been thoroughly discussed at the Conference held last week. The papers on factory and trade smoke abatement were of an excellent type, Commander W. T. Caborne, C.B., discussing the question of stoking and smoke abatement, and Dr. Rideal presenting a valuable report upon the abatement of smoke in factories. Commander Caborne reminded the Conference of the importance of stoking in general and the vast improvement in the methods employed during recent years. He pointed out that one great difficulty which had to be contended with, in many large towns and cities, and particularly in London, is the lack of room for the additional boilers required by individual factories owing to the expansion of their trade. This necessitates the burning of more coal per square foot of grate surface per hour under the boilers already installed, and it appears to be not unusual for 40 lb. of coal, or even more, to be so consumed per square foot of grate surface per hour; whereas, in normal cases, 20 lb. of coal would give a higher proportional efficiency.

THE NEW ST. LAWRENCE RIVER BRIDGE. SOUTH ANCHOR ARM, OCTOBER 30TH.

It cannot be too strongly impressed that the forcing of inadequate boiler power is one of the prolific causes of factory smoke. It would seem, therefore, that the time is not far distant when huge chimneys will give place to small ones and suction fans, and the waste gases will be used to heat the air supplied through the ash-pits. The adoption of that principle would tend to reduce the smoke nuisance, as by its introduction perfect combustion would be more nearly obtained.

Dr. Shaw discussed the problem whether London fog is inevitable, and it is obvious that the consideration of this question has an important bearing upon the more immediately practical question of the abatement of coal smoke. Dr. Shaw asserts that it ought to be possible to find a substitute for our accustomed methods of warming and cooking, and Sir William Preece added the weight of his authority to the need for use of improved methods of consuming fuel in factories and private houses. In this connection he emphasised the importance of large central electric supply stations for providing energy for power purposes. Sir William Preece also gave instances of firms who had found that smoke abatement in their own works had been allied with fuel economy, and of course if once manufacturers realise this fact, a considerable impetus will have been given to the smoke abatement reform.

There is another aspect of the question from the point of view of the saving to be effected, which will commend itself to property owners in our large cities. It was pointed out, in a paper recently read by Mr. Henry Leffmann, before the Engineers' Club of Philadelphia, that the abnormal conditions in modern cities have a high destructive action on building material. The use of coal increases very much the proportion of carbonic acid in the atmosphere and adds notable amounts of sulphurous and sulphuric acids. These acids, caught by the rain or fog, are deposited on the surface of the stone and produce corrosion. The solid particles of the smoke, partly carbon, partly the fine gritty material of the ash, are blown against the stone and act with more or less force as abrasive materials. In consequence of these injurious influences, some building materials that last a long while in rural districts succumb rapidly in manufacturing localities.

As long ago as 1892, in the columns of the National Review, Mr. Thwaite proposed to abolish London fog by instituting gas fires for coal. It was shown that the obnoxious characteristics of the smoke fog are essentially due to the presence of hydro-carbons and the sulphurous constituents of the coal generally used. Coal gas, when properly used, has almost all the advantages without any of the evils of the coal fire. He claimed that if we were less wasteful of the products of combustion we should not have to ransack Chili and Peru for artificial manures. It was urged that the distribution system of Pittsburg, with its 3,000 miles of mains (1892), might, with advantage, be followed in London, and that gas ought to be the fuel used in all London firegrates, particularly for cooking purposes.

It was also suggested that gas-generating stations for this purpose might be established in the centre of the coal-fields of South Yorkshire, Staffordshire, and South Wales, the gas to be conducted to the Metropolis through high-pressure mains. It was estimated that the cost, including that of the generating plant, would probably not exceed £11,000,000. The monetary value of the clear saving to the citizens of London was estimated at no less [illegible]

PAGE'S WEEKLY

An Illustrated Technical Weekly, dealing with the Engineering, Electrical, Mining, Iron and Steel, and Shipbuilding Industries.

DAVIDGE PAGE, Editor.

Clun House, Surrey Street, Strand, London, W.C.

Telephone No. [illegible]349 GERRARD

Telegraphic and Cable Address "SINEWY, LONDON."

Editorial.—*All communications intended for publication should be written on one side of the paper only, and addressed to "The Editor."*

Any contributions offered, as likely to interest either home or foreign readers, dealing with the industries covered by the Weekly, should be accompanied by stamped and addressed envelope for the return of the MSS. if rejected. When payment is desired this fact should be stated, and the full name and address of the writer should appear on the MSS.

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The Editor does not hold himself responsible for the opinions expressed by individual contributors, nor does he necessarily identify himself with their views.

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When Foreign Subscriptions are sent by Post Office Orders advice should be sent to the Publisher.

Foreign and Colonial Subscribers receiving incomplete copies through newsagents, are requested to communicate the fact to the Publisher, together with the agent's name and address.

New Copy for Advertisements,

Alterations, &c. intended for insertion in the current week's issue must be delivered **not later than 4 p.m. on Monday.** If proofs are required the copy and blocks should reach us several days earlier.

NEWS ITEMS.

In the [illegible] motor boat and motor-engine show is to be held at Glasgow.

At the weekly meeting of the London County Council a recommendation was agreed to for the expenditure of £436,000 on the second portion of the Greenwich generating station.

The Glasgow Electricity Committee recommend that application be made for further borrowing powers to the extent of at least £240,000, for additional plant, which is to include two turbine-driven generators of 4,500 h.p. each.

A memorial signed by 150 members of Parliament, presented on behalf of the National Physical Laboratory to the Chancellor of the Exchequer asks for a building and equipment grant of £30,000, of which £5,000 only, has been received, and for an undertaking that the grant shall be gradually increased to a sum of £10,000 a year.

At Tuesday's meeting of the Institution of Engineers and Shipbuilders in Scotland the following papers were read: On "The Evolution and Prospects of the Elastic Fluid Turbine," by Mr. R. M. Neilson, Manchester, and on "The Application of Calculating Charts to Slide-Valve Design," by Mr. William J. Goudie, B.Sc.

At a meeting of the Thames Conservancy the tender of Sir John Jackson, Ltd., was accepted for the dredging of 500,000 cubic yards of material from the Thames at the Lower Hope. The contract price of this work is to be 1s. 4½d. per cubic yard, and it is to be commenced within fourteen days of the signing of the contract, and completed within a year.

CONTENTS.

ELECTRIC LIFTING PULLEY BLOCK.

A Wire Mill Accessory.

The above illustration shows a useful form of electric lifting pulley-block, specially designed by Mr. S. H. Heywood of Reddish, near Stockport, for use in wire mills. They are made for loads up to four tons, to run on an overhead joist, travelling motion by hand, or for loads over one ton with automatic motion, taking the current from an overhead trolley-wire. The illustration shows an electric pulley-block of one ton capacity, working over the cleaning tanks of a large wire mill. The motor employed is totally enclosed, the whole of the mechanism being free from injuries by acid. The blocks are self-sustaining, and are controlled by the simple movement of pulling a small hand rope through a distance of a few inches. An electric brake is fixed on the motor spindle, and is such that when the current is switched on to the motor it is released. Immediately on cessation of the current, the brake is applied, and prevents running down of the load.

Society of Engineers.

The fifty-first annual general meeting of the Society of Engineers was held at the offices of the society, 17, Victoria Street, Westminster.

The chair was occupied by Mr. Nicholas J. West, president. The following gentlemen were duly elected by ballot, as the Council and Officers for 1906, viz.: As president, Mr. Maurice Wilson; as vice-presidents, Messrs. R[illegible] St. George Moore, Joseph William Wilson, and William Henry Holtum; as ordinary members of Council, Messrs. John Aird, Joseph Bernays, Alexander Graham Drury, George Abraham Goodwin, George Green, Edward John Silcock, Diogo Andrew Symons, and Francis George Bloyd; as honorary secretary and treasurer, Mr. David Butler Butler; as honorary auditor, Mr. Samuel Wood, F.C.A.

The president announced that the Rt. Hon. Lord Rayleigh, F.R.S., O.M., Chairman of the National Physical Laboratory, and Sir Alexander Richardson Binnie, president of the Institution of Civil Engineers, had been elected by the Council as honorary members of the Society, thus filling the vacancies created in the list of honorary members by the deaths of Sir Lowthian Bell, Bart., F.R.S., and Mr. James Mansergh, past-president of the Institution of Civil Engineers.

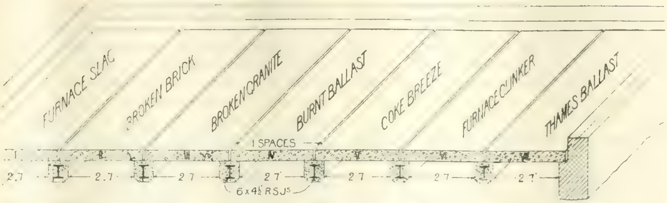
It was also announced that the following premiums had been awarded by the Council for papers read during the session, viz.; The president's gold medal to Mr. Sherard Cowper-Coles for his paper on "The Metallic Preservation and Ornamentation of Iron and Steel Surfaces;" The Bessemer premium of books to Mr. Ernest Romney Matthews for his paper on "The Parade Extension Works at Bridlington;" a Society's premium of books to Mr. Benjamin Laurenson Bradley for his paper on "The Grindleford Stone Quarries and their Working"; and a Society's premium of books to Mr. William Pollard Digby for his paper on "Statistics of British and American Rolling Stock."

Chinese Iron Ore Deposits.

It is said that an important concession has been obtained by Sir John Lister Kaye in the province of Anhui, Yangtse Valley, China, where it is believed a deposit of iron ore exists at a distance of 3½ miles from the Yangtse River. The concession is granted for a period of sixty years, with a possible extension, and the total area of the concession is about 50 square miles. It is estimated that there are 6,500,000 tons of iron ore in sight.

New Calendars.

From Messrs. Partridge and Cooper, Ltd., 191 and 192, Fleet Street, E.C., we have received a serviceable wall calendar, printed in black and red with ¾ in. figures; also a smaller calendar which has some useful information on Post Office and other matters. Samples of the firm's well-known desk diaries are also to hand, one of them having an ingenious arrangement by which a whole week's engagements are exposed to view by tearing off a slip for each day as it passes.



No. I	No. II	No. III	No. IV	No. V	No. VI	No. VII
Top slab cracked across in two places	Top Slab cracked across in three places; slight [illegible] downwards	Top slab cracked across in three places; curved downward about [illegible] in.	Top [illegible] cracked, not curved downwards	Top [illegible] curved [illegible] ward	[illegible] cracked [illegible] curved [illegible]	Top Slab cracked across in very many places, curved downward about [illegible] in.
Underside curved downwards [illegible] in. slight cracks visible	Underside curved downwards [illegible] in. slight cracks visible	Underside Curved downwards [illegible] in. no cracks visible about 1 in. washed off by water.	Underside Not curved downward, no cracks visible [illegible] washed off underside [illegible] by water	Underside [illegible] curved [illegible] visible about [illegible] washed [illegible] slab [illegible] water	Underside Not curved [illegible] slight [illegible] visible [illegible] deep [illegible]	Underside curved downwards 1½ in. and bad cracks all over in all directions, mainly longitudinally, [illegible] washed off by water

DIAGRAM AND TABLE ILLUSTRATING FIRE TEST OF CONCRETE AGGREGATES.

Fire-Resisting Aggregates for Concrete.

The accompanying diagram from red book No. [illegible] just issued by the British Fire Prevention Committee, shows in brief the effect of a test which has been carried out on cement concrete floors with bays of various aggregates. It is admitted that the test does not go far enough to draw definite conclusions, except to show the entire unreliability of Thames ballast concrete as a suitable material for this method of construction. The committee, however, hope to undertake further tests on similar lines.

The object of the test was to record the effect of a fire of three hours' duration, the temperature to reach 1,800 deg. F. (982·2 C.), but not to exceed 2,200 deg. F. (1,204·4 C.), followed by the application of water for two minutes.

The area of the floor under investigation was divided into seven equal bays of different aggregates, the quantity and quality of Portland cement used being identical for each bay. The nature of the concrete used was as follows:—

No.			Parts by volume.
I.	Slab concrete	Blast furnace slag	[illegible]
		Clean sand	2
		Cement	1
II.	Broken brick concrete	Broken brick	[illegible]
		Clean sand	[illegible]
		Cement	1
III.	Granite concrete	Broken granite	[illegible]
		Clean sand	[illegible]
		Cement	[illegible]
IV.	Burnt ballast concrete	Burnt ballast	[illegible]
		Cement	[illegible]
V.	Coke breeze concrete	Coke breeze	[illegible]
		Cement	[illegible]
VI.	Clinker concrete	Furnace clinker	3
		Clean sand	2
		Cement	1
VII.	Thames ballast concrete	Thames ballast	3
		Clean sand	2
		Cement	1

The total area of the floor under investigation was to be at least 200 ft. super (18·58 m.).

The soffit of each bay exposed was to be about 10 ft by 2 ft. 7 in. (3·04 m. by ·787 m.), the thickness being 5½ in. (·139 m.).

The floor was to be loaded with 224 lb. per ft. super (1,093.7 6 kg. per m.).

The centring was to be struck fourteen days after completion of the floor. The time allowed for drying was forty days (autumn).

In ten minutes after the gas was lighted the plaster began to fall off the beams and continued to do so until the end of the test.

Towards the end of the test it was observed from the top of the hut that the edges of bays Nos. I., VI. and VII [illegible] No. VII being the worst

[illegible] plaster was washed off the beams than had fallen during the fire test, and some of the concrete from the underside of bays Nos. III., IV., V., VI., and VII., was washed off.

All the slabs remained in position.

Bay No. VI. was flat on the soffit, all the others were convex on the underside, No. VII. (the worst) to the extent of 1¼ in.

On the removal of the load it was found that bays Nos. I., II., III., VI., and VII. were cracked across, No. VII. being worst.

The committee attach considerable importance to this test with materials in every day use, and not subject to proprietary rights. It is the first of a special series.

Institution of Civil Engineers.

The last monthly ballot resulted in the election of eleven members, viz., J. G. Barkley (Shanghai); J. A. Bensel (New York); J. C. Cadman (Madeley, Staffordshire); C. J. B. Cooke (Crewe); V. da S. Friere (Sao Paulo, Brazil); W. C. Hall (Preston); E. R. Hill (London); A. W. Karlson (Pretoria); R. Matthews (Heaton Mersey); A. R. Trevithick (Créwe); G. B. Wilkinson (North Shields).

International Catalogue of Scientific Literature.

The British representatives on the executive committee, on whom the management has practically devolved, have, during the year, been Prof. Armstrong (chairman), Prof. Larmor, Dr. L. Mond, and Dr. Thorpe, while the treasurer of the Royal Society has again, by request, attended the monthly meetings as financial assessor. The first two annual issues of the catalogue have now been completed, as well as most of the third, while the preparation of the fourth is well in hand, and it is expected that a beginning will be made on January 5th, next. The total number of slips received since the beginning of the undertaking is 590,884. Allowing for rejected slips and new slips prepared by the Central Bureau, 548,159 have been printed or are now at the printers, and 114,051 which [illegible] at the Central Bureau.

The Postmaster-General has issued a notice calling attention to the revised edition of the Post Office Guide. The principal tables have been recast and [illegible] and in the new edition not only has unnecessary and redundant [illegible] considerable amount of [illegible]

New Armour Plate Rolling Mill.

The erection, says the Sheffield Telegraph, has just been completed at Messrs. Cammell, Laird and Co.'s, works in Sheffield, of a new armour-plate rolling mill, the largest mill of this kind in the world. The driving engines are of 14,000 h.p., each roll weighs 42 tons, and between the roll-housings they are 42 ft. 6 in. in length. The engines have been built by Messrs. Davy Brothers, of Sheffield, but the rest of the work, the roll-housings, the rolls, and live roller gear have been made by Messrs. Cammell, Laird and Co. themselves. Preliminary trials of the engines have proved them to be in perfect working order, and work at the new mill will be shortly commenced.

The Chemical Metallurgical and Mining Society of South Africa.

The following have been elected members of the above society: Harry H. Balfour, M.B., C.M., Cleveland; George Duncan Brown, c/o Messrs. Mercer, Nicolaus and Co., P.O. Box 3,443, Johannesburg, mine manager; Ross Earle Douglas, O.P. Box 33, Bulawayo, mine manager; John Robert Gilfillan, Buffelsdoorn Estate and G. M. Company, Ltd., P.O. Box, 113, Klerksdorp, Cyanider; Louis G. Irvine, M.A., M.D., Crown Reef G. M. Company, Ltd., P.O. Box 1,081 Johannesburg; C. C. W. Liddelow, East Rand Proprietary Mines, Ltd., P.O. Box 66, East Rand; Donald Macaulay, Cleveland; R. E. Patterson, East Rand Proprietary Mines, Ltd., P.O. Box 66, East Rand; W. Roff, East Rand Proprietary Mines, Ltd., P.O. Box, 66, East Rand (transfer from Associate Roll); Robert Ogilvy Weston, Globe and Phœnix G.M. Company, Ltd., Queque, Rhodesia, engineer and mill manager.

Mr. Gilbert C. Vyle, A.M.I.E.E., has resigned his position as works manager and assistant to the general manager of the Telephone Department of the General Electric Company's Works at Salford, and has commenced practice as a consulting engineer at 14, Ridgefield, Manchester. He is specialising in works organisation, telephone and signalling systems, and automobiles.

The Acme Spinning Mill, at Pendlebury, Manchester, the first in England to be electrically equipped and chimneyless has just been opened. The current is supplied by the Lancashire Electric Power Company. Other mill-owners in Lancashire are also adopting electric power.

By the end of 1907 the port of Hamburg will possess a floating dock (now under construction in the shipyard of Messrs. Blohm and Voss, at Hamburg), which will accommodate the largest warships and liners.

BEHAVIOUR OF MATERIALS OF CONSTRUCTION UNDER PURE SHEAR.

By E. G. Izod.

THESE experiments were carried out at University College Engineering Laboratory and were undertaken in the first case to investigate the effect of shear on cast-iron, concerning which there seemed rather a lack of data, and these proving useful they were extended to embrace a somewhat wider field as shown in the results attached. The main stumbling block in experiments on shear seems to be that bending, or stretching of the outer fibres in the specimens tested, cannot be entirely eliminated, and to remedy this as far as possible a particular form of shearing apparatus has been used.

The apparatus is shown in fig. 1; *a* is a stiff cast-iron body composed of two projecting supports, which are cast in one with the bedplate. These supports carry hardened steel plates *bb* with edges ground for cutting edges; these side plates are screwed to the supports by the holding-down bolts which grip the specimen, the edges being spaced exactly 4 in. apart, which is the general span adopted for the experiments. The plates are capable of fine adjustment by means of the small set-screws *cccc*. Between these side plates another cast-iron block *d* slides, which also holds a steel plate *e* with cutting edges; this middle plate exactly fits between the two side plates so that the opposite edges shall induce as near perfect shear as possible. The specimen is then screwed down to the middle plate by means of the cap and holding-down bolts, and the projecting ends placed on the two side plates, and held firmly by the caps *g* and side bolts; the whole apparatus is then placed between the compression plates of the testing machine, and the tests carried out in the usual manner. The projecting lugs *h* served as guides to ensure the middle block *d* moving fairly between the side plates.

The testing machine used was a 100,000 lb. Greenwood and Batley horizontal machine, and all the jockey weights were carefully calibrated. The specimens used were as nearly alike as could possibly be obtained, but a great deal depended on the form in which the material was supplied, this varying with different makers; in all cases a rectangular section was used for the shearing tests, while for the tensile tests a general rule was followed where possible for the flat and round specimens.

EFFECT OF FORM OR SHAPE OF SECTION

Several experiments were made in the early stages to determine the effect of form or shape of section on the ultimate shear stress, which perhaps deserves a passing mention. A mild-steel bar was taken and specimens cut from it consecutively, and treated in a different manner as regards the shearing area, such as :—

(1) Nicked with various widths of cutting tool.

(2) Fine saw cuts to various depths.

(3) Turned grooves with various radii at the bottom.

(4) Recesses machined for the knife-edges, etc.

These gave results practically identical with those from the plain bar, so that the rectangular sections as tested could be relied upon to give satisfactory results and an accurate measure of the ultimate shear strength for all materials.

A summary of all the results obtained is shown in Table 1. and plotted against materials base in fig. 2 (see page 1366). Each figure in the table is the mean of a large number of separate tests; where the elongation percentage is given, it is the corrected elongation percentage for a standard bar 2 in. long and $\frac{9}{16}$ in. diameter, having therefore a ratio of $\frac{l}{d} = 3.54$

Ultimate tensile stress is designated by *Ft*.

Ultimate shear stress is designated by *Fs*.

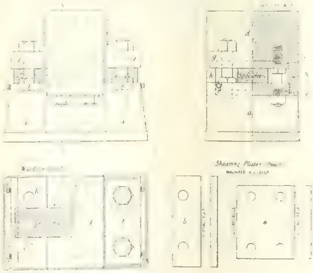


FIG. 1.—GEAR FOR SHEAR EXPERIMENTS.
(Sections 8 and 9, plate 1.)

SHEAR TESTS.

Fig. 2.—Results plotted on "Materials" Base. (See Table I.)

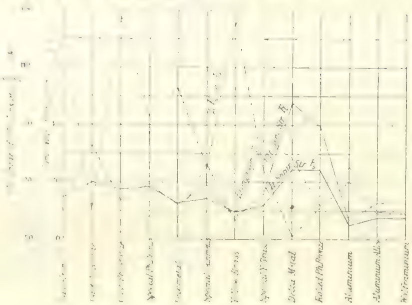


Fig. 3.—Results on Steel Plotted against "Material" representing various qualities of Steel (See Table I.)

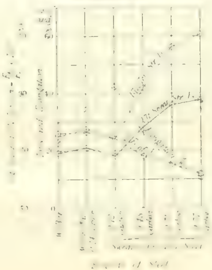
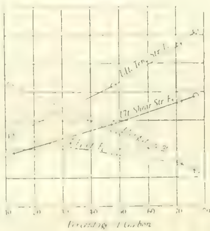


Fig. 4.—Results on Swedish Crucible Steel with varying Percentages of Carbon



Summary Table of Results.

Plotted on "Materials" Base, Figs. 2, 3 and 4.

Material	Ultimate Tensile Stress. Tons per sq. in. = F_t	Elongation Percentage on Standard	Stretch Modulus E. Tons per sq. in.	Ultimate Shear Stress Tons per sq. in. = F_s	Per cent of Ultimate Shear of Ultimate Tensile Stress $= \frac{F_s}{F_t} \times 100$
Cast-Iron. A	9·7	—	6000	14·8	152·0
,, ,, B	13·4	—	8300	17·4	111·0
,, ,, C	11·3	—	5700	13·9	122·0
,, ,, D_1	13·7	—	6200	16·1	118·0
,, ,, D_2	13·5	—	5900	14·8	110·0
Cast Aluminium-Bronze	33·1	12·5	7600	19·9	60·0
,, Phosphor Bronze	13·4	2·2	—	17·2	128·0
Special Cast Phosphor-Bronze	19·7	8·0	—	18·4	93·0
Gunmetal	12·1	7·8	—	12·5	103·0
Special Gunmetal	19·0	26·5	—	14·5	75·0
Yellow Brass	7·5	6·5	—	9·4	126·0
Special Yellow Brass	16·0	35·0	—	11·8	74·0
Delta Metal	17·3	28·3		21·2	51·0
Rolled Phosphor-Bronze	39·5	11·7	—	21·2	61·0
Aluminium	6·4	25·5	—	4·5	70·0
Aluminium Alloy	12·7	9·6	—	7·5	59·0
Wolframinium	12·6	9·2	—	7·5	59·0
Wrought-iron Bar	26·0	22·5	—	19·4	75·0
Mild-Steel Plate 0·14 Carbon	26·9	34·7		21·0	78·0
Swedish Crucible Steel:—					
0·12 Carbon	24·9	13·0	—	18·5	74·0
0·48 ,,	42·1	26·0	—	28·8	68·0
0·71 ,,	56·5	15·0	—	36·6	65·0
0·77 ,,	61·3	11·0	—	38·5	62·0

TABLE I.

CAST IRON.

Four brands were tested, and the mean results give a higher ultimate shear stress for cast-iron than is generally accepted; the average for all brands being 14·9 tons per square inch, while in several cases it exceeded 16·0 tons. An attempt was made to establish [illegible] as a guide to the ratio $\frac{Fs}{[illegible]}$ but this ratio did not seem to be dependent on any of the other results observed. Though the variation with different brands is not great, yet it cannot be said to follow any law which can be deduced from these experiments. Analysis is plotted against these results in fig. 5. The fractured specimens showed that, even though the material was well supported round the knife-edges by the holding-down caps, yet a local stretching took place in the outer skin, in this case of course showing as a slight crack across the specimen about $\frac{1}{8}$ in. from the shearing plane. It was observed also that the fracture line took the form of an S bend with the bulge towards the knife-edge.

CAST ALUMINIUM BRONZE.

These specimens have a high ultimate tensile stress with rather low ultimate shear stress, the ratio $\frac{Fs}{Ft}$ being only 60 per cent. The shear fracture did not show much sign of the knife-edges having had a cutting action on the material, it having apparently stood the load up to the maximum without much deformation, and then entirely fractured at this load.

CAST PHOSPHOR-BRONZE.

[illegible] ordinary material [illegible] high ratio $\frac{Fs}{Ft}$ [illegible] the same material was specially treated in casting, with the result that the whole of the figures were improved, the ratio $\frac{Fs}{Ft}$, however, decreasing from 128 to 93 per cent. A very curious fracture was observed with the special material, which is a very aggravated form of the fracture noticed in mild-steel, etc. When the specimen was sheared, it was found that the fracture line had taken two distinct paths in such a manner that there was a plug of the material left in the shear plane, untouched by the knife-edges. This fracture appeared [illegible]

OTHER METALS AND ALLOYS

In the case of gunmetal similarly to that of phosphor-bronze, the special treatment has considerably improved the test figures, though the ratio $\frac{Fs}{Ft}$ has [illegible]

With yellow brass the improvement due to special treatment is here even more marked than in the two previous cases, though the variation in results is what might be expected from the former tests.

Delta metal gave the highest ultimate tensile stress of all the materials, the ultimate shear stress being equal to that of rolled phosphor-bronze, while the ratio $\frac{Fs}{Ft}$ [illegible] per cent. The shear fracture was [illegible] and clean, but presented a curious feature in that the material showed no trace of cutting of the knife-edges except at the extreme outside of the specimen, where the metal had apparently bunched up into a knot and was either entirely cut by the descending knife-edges or else torn clean away, leaving two projections in one portion of the sheared specimen with corresponding recesses in the other.

Rolled phosphor bronze proved very tough material, with high ultimate tensile stress 39·5 tons per square inch, and a fairly low elongation. The ultimate shear stress was 24·2, and there is a rather low ratio $\frac{Fs}{Ft}$ of 61·0 per cent. Shear fracture was very smooth and clean, and showed traces of the knife-edges, with very little stretching of the outer fibres.

Aluminium gave fairly high elongation with ratio $\frac{Fs}{Ft}$ [illegible] Shear fracture was smooth and clean, showing the cutting action of the knife-edges very plainly.

With an aluminium alloy the ultimate tensile stress was nearly double that of aluminium, while the ratio $\frac{Fs}{Ft}$ [illegible] per cent. or 10 per cent. less.

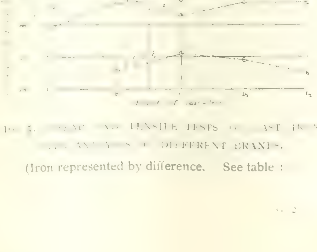


FIG. 5. [illegible] TENSILE TESTS [illegible] CAST IRON [illegible] DIFFERENT BRANDS.

(Iron represented by difference. See table [illegible]

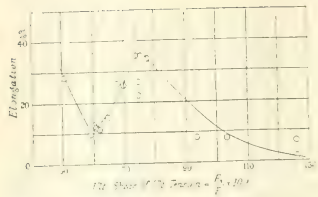
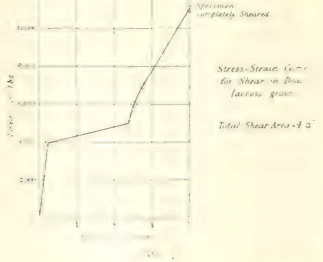


FIG. 6. CURVE SHOWING POSSIBLE VARIATION OF ELONGATION PER CENT.

Wolframinium gave results almost coinciding with the former aluminium alloy, the only difference being, if anything, slightly lower elongation percentage. The shear fracture was similar to No. 4 alloy and mild-steel.

MILD STEEL AND WROUGHT IRON

It was intended to make these tests on a large number of steels with varying percentages of carbon, including the higher carbon steels; but, unfortunately, steel makers, who would have supplied a series of test pieces with their proportionate analyses, were not able to furnish them at the last minute; consequently the experiments are not so complete as they might be. The author was enabled to include however a series of tests on some Swedish crucible steel, with varying percentages of carbon, and these results are plotted in fig. 4. Contrary to expectation, the ratio $\frac{Fs}{Ft}$ decreased as the carbon content increased; but the author is inclined to think that this confirms the



deductions arrived at from the curve in fig. 6 and explained later, namely, that as the ratio $\frac{Fs}{Ft}$ falls from 80 to 60 per cent. the elongation percentage also decreases, whereas, if the elongation dropped considerably lower than 10 per cent., as might be expected with higher carbon steels, the ratio $\frac{Fs}{Ft}$ would be proportionately higher.

FORM OF FRACTURE IN MILD STEEL

A very curious feature of the tests on mild-steel was the peculiar form of fracture, there being left a very decided knife-edge standing away from the rest of the material. This peculiarity was noted in two other materials tested; and to investigate it, a specimen of mild-steel was specially prepared with horizontal and vertical lines drawn $\frac{1}{32}$ in. apart, each side of the shearing plane; this was then placed in the machine and the load taken off when the specimen was half-sheared. When the knife-edges move towards one another under the gradually applied load, the fracture line starts obliquely from each, and as they come together the fibres of the intervening materials are compressed and twisted through nearly a right angle until finally fracture takes place along the fibres. The knife-edges separate this isolated portion through the vertical plane in which they are forced to move, thus making the ridge mentioned, the front of which is due to the cutting action of the knife-edge, while the back is due to the primary fracture line at the commencement of the load. This experiment also showed that it was practically impossible to prevent a certain amount of stretching of the top fibres in shearing tests, as, though the material was well supported by the holding-down caps, these fibres were effected for $\frac{1}{2}$ in. each side of the shearing plane, as shown by the inclination of the top portion of the vertical lines; this stretching or bending is due to the fact that, when the load comes on the specimen, a certain amount of compression takes place before any fracture occurs, which brings the material away from the holding-down caps, and so leaves it to a certain extent unsupported and free to stretch.

WOODS

Four kinds of woods were used for these tests—Pollard oak, yellow deal, yellow pine, and teak.

From a selected board of each, specimens for tension and shear were cut alternately, in order to ensure any possible variation in the quality of the board being well distributed. The shear specimens were cut 8 in. by 2 in. by 1 in., and tested along and across the grain. The results are given in Table 2 (page 1369).

Kind of Wood	Weight of Cubic Foot.	Ultimate Tensile Stress.		Across Grain Crippling Load.	Ultimate Shear Stress.		Percentage Crippling Load across Grain of Ultimate Tensile Stress.	Percentage Ultimate Shear Stress across Grain of Ultimate Tensile Stress.	Percentage Ultimate Shear Stress along Grain of Ultimate Tensile Stress.	Percentage of Moisture.
					Across Grain.	Along Grain.				
	Lbs.	Lbs. per sq. in.	Tons per sq. in.	Lbs. per sq. in.	Lbs. per sq. in.	Lbs. per sq. in.				
Pine .	39·5	9,176	[illegible]	1,930	4,872	470	21·0	53·0	5·12	15·7
Oak .	47·7	15,993	7·14	Apparently none	5,292	[illegible]	—	[illegible]	[illegible]	12·6
Deal .	26·46	[illegible]	[illegible]	1,195	[illegible]	442	15·2	34·0	[illegible]	[illegible]
Teak .	45·0	9,807	4·37	2,764	[illegible]	1,022	28·2	40·4	10·4	[illegible]

TABLE 2. TESTS OF WOOD IN SHEAR AND TENSION.

On testing the woods in shear across the grain, it was observed that the specimen remained steady up to a certain load, and then sheared through about three-fourths of its shearing area, when it required a further increase of load, sometimes as much as twice the amount to completely shear the specimen; the author has named this the "crippling load," and it is shown more clearly in a shear stress-strain diagram, fig 7, which was drawn for a specimen of deal sheared across the grain. The exception to this is the case of oak, where no "crippling load" is really apparent, and which sheared through at its maximum load directly the centre knife-edge commenced to move. In teak specimens sheared across the grain, the fibres did not hold together as in the other woods, but broke away from the main specimen at about ¼ in. from the shearing [illegible].

The percentage of moisture in each wood was obtained by carefully weighing the broken specimens, then placing them in a temperature of 212 deg. F. for eighty hours and weighing again immediately on removal. Towards the conclusion of the experiments it occurred to the author that the apparently pure double-shear, induced by the apparatus used, might not be simultaneous over the whole area, and to investigate the matter an arrangement was adopted as follows: To the centre block carrying the middle knife-edge a stiff steel beam was screwed, each end of which carried a steel pointer; to the crosspiece of the testing machine which carried the compression plate two brackets were fixed, which carried smoked iron plates, the steel pointers on the beams resting lightly on each, and were adjusted with springs to move without friction on the plates. The multiplying effect each side of the centre block was, by means of the long steel beam, 16 to 1, that is, a movement of ¼ in. on the pointer would mean a corresponding movement of the knife-edge of $\frac{1}{64}$ in. A specimen was placed in the shearing shackles, and the whole just gripped between the compression plates sufficiently to prevent slipping; the steel beam was then screwed down to the centre block, and the pointers adjusted to just rest lightly on the smoked plates. A zero line was then drawn on each plate at the place where the pointers rested; small increments of load were then put on, and each pointer carefully watched and the positions marked for the corresponding loads. It can be seen that should there be any tendency of the knife-edges not to move absolutely in synchronism due to even a small failure of one side of the specimen before the other, the beam would immediately set itelt at some small angle, and consequently the pointers would record the movement and locate it. This arrangement would also give a fairly accurate stress-strain diagram for any material tested, and some observations were taken on a specimen of yellow deal, from which the stress-strain curve, fig. 7, was plotted. A specimen of mild steel bar tested with this gear on showed that the material remained perfectly steady up to half its maximum load, after which it began to shear, the movement of the knife-edges being regular

for successive increments of load until fracture took place. In all the experiments this arrangement showed that there was no tendency for one side to fail before the other, the shear being apparently simultaneous over the whole area.

All the results obtained in these experiments seem to point to the fact that there is no common law connecting the ultimate shearing stress with the ultimate tensile [illegible] $\frac{f}{F}$, varying greatly with different materials. The test figures from the crystalline materials such as cast-iron or those with very little or no elongation, seem to indicate that the ultimate shear stress exceeds the ultimate tensile stress by as much as 20 or 25 per cent., while from the fibrous materials, or, more properly speaking, those with a fairly high measure of ductility, the ultimate shear stress may be anything from 0 to 50 per cent less than the ultimate tensile stress.

[illegible] showing the variation of elongation percentage with the ratio $\frac{f}{Ft}$ and from this it can be seen that there is a certain amount of uniformity in the results. When the ratio [illegible] per cent. the elongation in every case shows very little variation from 10 per cent. Below, and above the 60 per cent. ratio, the elongation increases, that at 50 per cent. ratio being almost equal to that at 70 per cent., while from the 70 per cent. ratio upwards the variation is inclined to be regular, the elongation decreasing as the ratio $\frac{f}{F}$ becomes higher, until with a very small or practically no elongation the ratio might be expected to reach 120 per cent. or 130 per cent., that is, that the ultimate shear stress would exceed the ultimate tensile stress by 20 or 30 per cent. Further experiments might throw more light on this subject, and the author regrets that he was unable to extend the series of tests to embrace a wider and consequently more interesting field.

[illegible] the Institution of Mechanical En[illegible]

The Charing Cross and City Co.'s Exhibition.

A permanent exhibition of the Charing Cross, City and West End Electricity Supply Company, Ltd. has been opened at 85, Fenchurch Street, for the [illegible] and power consumers in the company's area. Flame, arc, tantalum and other types of lamps, electric heating and cooking apparatus motors driving various tools, electric lift equipments, air-compressing plant, ozonising apparatus, and the [illegible] for practical demonstration.

Mining Institute of Scotland.

A general meeting of the Mining Institute of Scotland was held in their new premises in Hamilton on Thursday, 14th inst., Dr. R. T. Moore presiding over an exceptionally large attendance of members.

A paper on "A Hydraulic Pumping Installation at Loanhead," by Mr. Robert Crawford, was afterwards discussed. The chairman said the principle of pumping water by hydraulics had now been applied at a number of colleges, both in this country and abroad. In Germany, in particular, large quantities of water were by this means pumped to great heads, and the same system was being applied at the docks for the installations of coal tipping. Personally he thought that a much larger and useful effect was got in this way than by electric or any other system. The discussion was thereafter closed and a hearty vote of thanks accorded the writer.

Mr. T. H. Mottram contributed a paper descriptive of the sinking of colliery shafts through sand at Ardeer, Ayrshire, by the pneumatic process, with notes on the subject of caisson ventilation and sickness.

Mr. J. T. Forgie, in opening the discussion, said that hitherto the most successful method of sinking through sand was the freezing process, and he should like, if possible, to be given an idea of the cost of sinking by the pneumatic process, because if it was not cheaper he should be inclined to abide by the freezing system. Professor Latham said, compared with freezing, his experience was that the pneumatic system was not only cheaper but much more satisfactory. In sinking by freezing there was always a difficulty of freezing water flowing in eddies or channels. Further discussion on the paper was adjourned.

At a meeting of the Council which was subsequently held, Mr. James Barrowman, jun., was appointed treasurer of the institute, in room of Mr. Archibald Blyth, who has occupied the position during a long [illegible]

Under-water Repairing of Ships.

[illegible] Captain [illegible] a number of visitors attended at the South West Dock on Tuesday afternoon to witness a demonstration of an apparatus designed to facilitate under-water work on ships, dock gates, and other under-water structures. The invention consists of a long canvas cylinder stayed by stout wooden hoops to enable it to resist water pressure, the feature of the apparatus being that the upper opening of the cylinder is always above water, and thus obviates any difficulty in the supply of air. At a convenient height from the base of the cylinder a window and shelves are fitted for the use of the workman.

NEW DESTRUCTOR AT ILKLEY.

THE question of the provision of a destructor at Ilkley has been under discussion by the Council for several years. It was finally decided in 1904 to erect a destructor adjoining the sewage works, where the clinker could be readily used for filter beds, and where a use for the power might ultimately be obtained.

A contract was entered into in November, 1904, with the Horsfall Destructor Company, Ltd., of Leeds, for the destructor, boiler, dust-catcher, and chimney, and with Mr. Waugh, a local contractor, for the buildings. These contracts were made subject to the approval of the Local Government Board, being obtained for the necessary loan; and, after the usual formalities, the work was commenced in the early summer of 1905.

The destructor, which has recently been opened, is of the "back-feed" type, and consists of two cells, each capable of burning 10 tons of refuse per twenty-four hours. The cells are of the Horsfall "back-feed" type, the refuse being tipped by the carts into a feeding bin at the back of the cells, then shovel-fed into the furnace through a gas-tight sliding door with balance weight, the clinker being withdrawn by a similar door at the opposite or front end of the cell. The forced draught is on the "Horsfall" patent "hot blast" system with side boxes, and the cells have the firm's special front exhaust flue. The cells are faced on the outside with salt-glazed bricks and lined on the inside with the best quality of firebricks and blocks. A special shoot is provided for the destruction of slaughter-house offal, which is cremated in the combustion chamber of the destructor.

The boiler is of the cylindrical multitubular type, and is of comparatively small capacity, there being no demand at present for a large quantity of power. There is, however, even with this small boiler, plenty of steam to spare, and machinery will shortly be installed for utilising at least a portion of the available power. A bye-pass flue is provided by which the gases may at will be led direct from the destructor to the dustcatcher, without passing through the boiler.

The dustcatcher is of the latest "Accrington" type, in which the dust contained in the gases is deposited in an external pocket, from whence it is readily withdrawn without interfering with the working of the plant. Practical tests have shown this dustcatcher to be capable of arresting over 98 per cent. of the dust contained in flue gases. The apparatus is strongly constructed in firebrick, and well stayed, so as to be very durable.

The chimney is 60 ft. in height from ground level to top of cap, and is lined throughout with firebrick. The site being near the river, special precautions had to be taken in the chimney foundation, for which, however, a good bottom was eventually found. It will be seen that even in such a situation as Ilkley, high chimneys are not necessary with well constructed modern destructor plants.

The erection of the destructor has been received with much satisfaction, for it has been felt for some time that the complete and sanitary disposal of house refuse was a most important point in the sanitation of the district, both for the benefit of the inhabitants themselves and also for the health and comfort of visitors.

The Council were advised throughout on this scheme by their engineer, Mr. Henry West, under whose careful supervision the work has been carried out. Mr. West's estimate for the whole job was £2,300, which has not been exceeded.

EXTERIOR OF ILKLEY DESTRUCTOR.

VIEW OF THE [illegible].

REINFORCED CONCRETE APPLIED TO MODERN SHOP CONSTRUCTION.

By E. N. HUNTING.

THE subject of shop construction is one of the most important problems that the mechanical engineer has to solve. Economy and limitation of capital render this problem one of great difficulty. Modern business methods require that money invested shall return substantial percentage of profit; consequently, it has been necessary for the mechanical engineer to devise some substitute for fire-proofed steel construction that will answer the same purpose for less money.

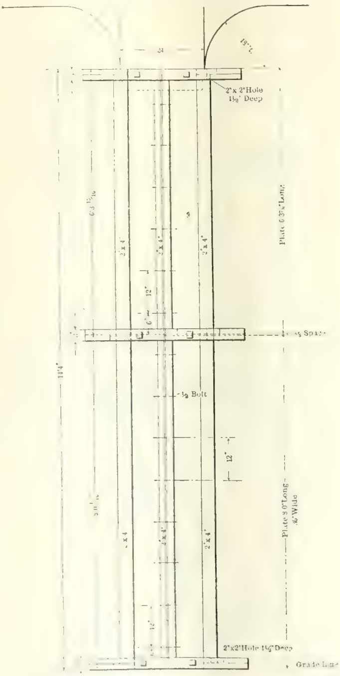
It is the writer's object to set forth a few of the advantages of reinforced concrete, and to show how well it lends itself to shop construction; also to give some data on actual work of this class.

ADAPTABILITY.

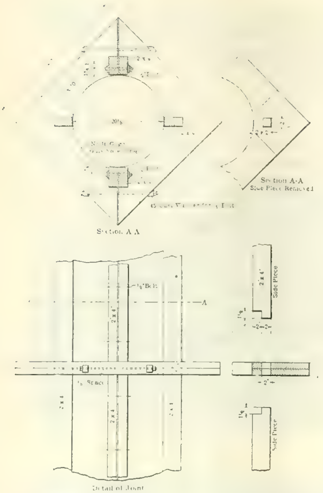
Concrete is a mixture of sand, stone, cement, and water. The increased demand for cement has caused plants for its manufacture to spring up in almost every locality. Sand, stone, and water can be obtained everywhere, locally. The mixture of the aggregates can be made by very efficient mechanical devices or by the use of the most ignorant class of labour—with the same good result. This mixture when completed can be moulded to any shape or form from the rough foundation to the most artistic design of cornice or capital. The steel reinforcements are of standard sizes and shapes, and are readily obtainable in any market on short notice. The tonnage of this steel work is small and of very light section, and requires no apparatus to set in position.

STRENGTH.

As a structural building member, reinforced concrete shows a very economical distribution of material. Steel is provided to take care of all direct tensional stresses and those shearing stresses for which the concrete is not sufficient. Compressive stresses are taken care of by the concrete. In other words, at least one-half the stress in a beam is provided for by the concrete, whose unit cost is comparatively low. The discussion of the various methods of calculation used in beam design has been very thoroughly taken up by our technical journals, and would require a paper in itself to thoroughly cover the ground. Most theories advanced are, however, based upon the common theory of flexure, no allowance being made for tension in the concrete. The theoretical discussion has been developed to a great extent by European engineers.



DETAIL OF [illegible] FOR 20-INCH CIRCULAR COLUMN.



FORM FOR 20-INCH CIRCULAR COLUMN.

FIREPROOF QUALITY.

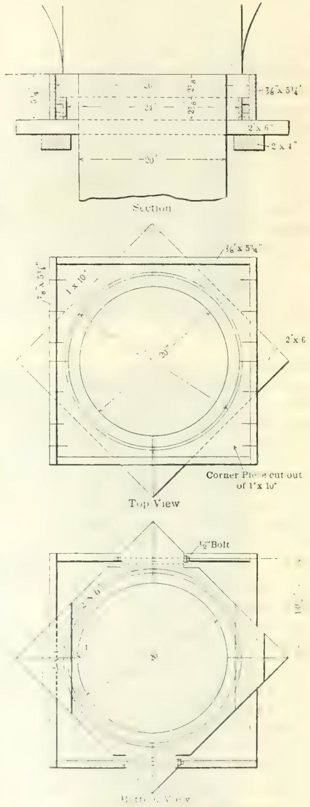
Concrete is a poor conductor of heat. Subjected to a high range of temperature, it gives up part of its water of combination, and becomes a much poorer conductor of heat than before. Hence there is but little danger of the tension steel in a beam giving away when well protected by concrete. After an examination of fireproof buildings in the path of the Baltimore fire by a committee of experts composed of H. B. Parsons, M.Am.Soc.C.E., S. C. Weiskopf, M.Am.Soc.C.E., and Carl Grieshaber, the conclusion was that reinforced concrete surpassed all other materials for fireproof qualities.

DURABILITY

Forces of nature, no matter how severe, have but little effect on concrete. Subjected to severe tests of acid fumes and high temperatures, as was the case at the fire in the Pacific Coast Borax Company's plant at Bayonne, N.J., concrete showed but slight signs of deterioration. Edwin Thacher, M.Am.Soc.C.E., in a paper before the International Engineering Congress, points out a number of tests that show steel properly protected by concrete will not deteriorate.

ECONOMY.

In shop construction, reinforced concrete is from 10 to 20 per cent. cheaper than a similar design of fireproofed structural steel. The largest cost item for concrete construction is for the forms. It can be readily seen that any decorative work adds materially to this



DETAIL OF FORM FOR COLUMN CAPITALS.

item; while the concrete itself costs no more in an artistic cornice than in any floor or beam, the mould in which it is placed requires the employment of highly-paid skilled labour in its manufacture. Compared with slow-burning types of construction, the costs vary in different parts of the country. In some sections reinforced concrete can be built for almost the same figure as slow-burning construction.

It seems almost incomprehensible that in the modern structural steel machine shop there is sufficient inflammable material to cause a destructive fire. It is true, however, that but very little fire is necessary to make a structural steel member give away when under stress.

EXAMPLE OF REINFORCED CONCRETE MACHINE CONSTRUCTION.

The Taylor-Wilson Manufacturing Company's plant at McKees Rock, Pa., is illustrated on this page. The ruling factors in the design of the Taylor-Wilson Manufacturing shop were: First, it should be an absolutely fireproof building; secondly, it should be built at a minimum cost; thirdly, provision should be made for heavy crane-ways; fourthly, the design should have some artistic value.

The shop is 160 ft. long and 102 ft. wide, and is carried on a series of foundation piers running down an average of 12 ft. to hardpan. These foundations were put in, and a fill made around them. In the rear of the building, which is on swampy ground, this fill was about 22 ft. In plan the shop consists of a centre aisle 51 ft. 7 in. wide, two lean-tos 18 ft on one side and 30 ft. wide on the other.

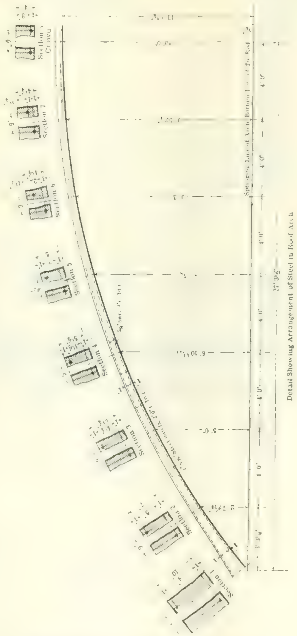
COLUMNS.

The entire building load is carried on four rows of columns. Two outside rows of 12 in. square, and two inside rows of circular columns 20 in. in diameter.

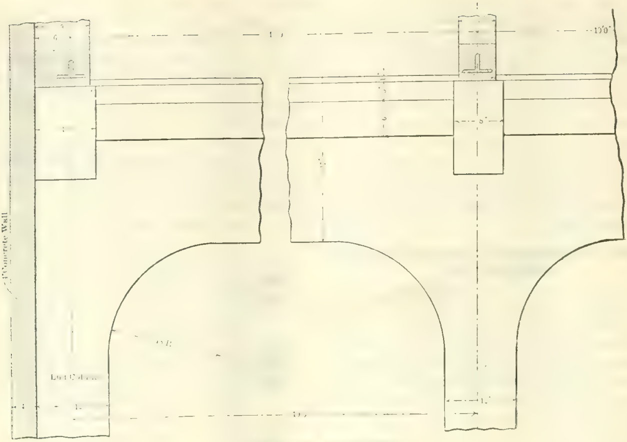
Fig. 1 shows the method used in construction of the moulds for the 20-in. circular columns. These moulds were formed of 16-gauge galvanised iron, and were very satisfactory, giving a perfectly true and smooth surface. The column reinforcement consists of four vertical rods, to which were attached a series of hoops $1\frac{1}{2}$ in. wide and $\frac{1}{8}$ in. thick, spaced 4 in. apart. In this connection it might be well to state that the vertical rods are considered useless as far as carrying the load is concerned, and come into play only when the column acts as a beam due to eccentric loading. The theory of this design is that compression is not a stress in itself, in reality failures by compression are failures by secondary tensional stresses within the material. It has been found by a long series of tests that a column failure is always due to a tendency of the concrete to bulge, consequently the strength of this design depends, above a certain loading, upon the strength of the bands encircling the concrete. Unit stresses as high as 10,000 lb. per square inch have been developed without signs of failure. These bands are rigidly attached to the verticals for spacing, and have a projecting fin that holds them to the proper distance from the form.

Where the column runs into the beam it will be noticed that the area is increased. The reason for this is that higher unit stresses are allowed in the hooped column than in the beam, so it is necessary to increase the area at the junction.

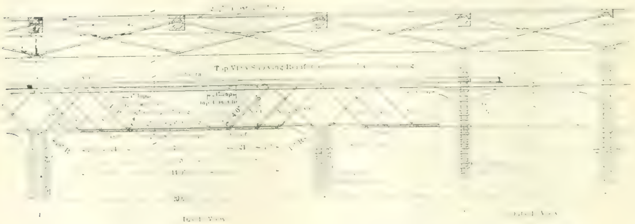
Fig. 5 shows the main beam of the building—the

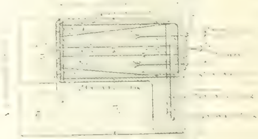


TAYLOR AND WILSON MACHINE SHOP, MCKEES ROCK, PA.

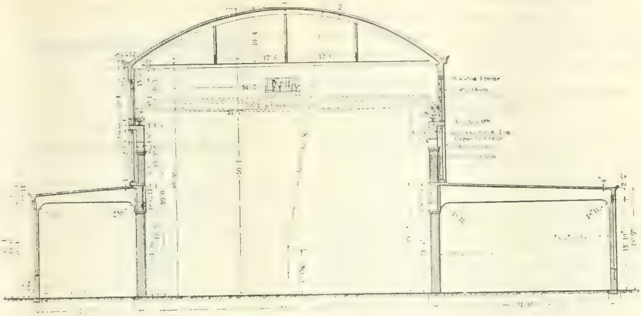


DETAILS OF ROOF BEAM.

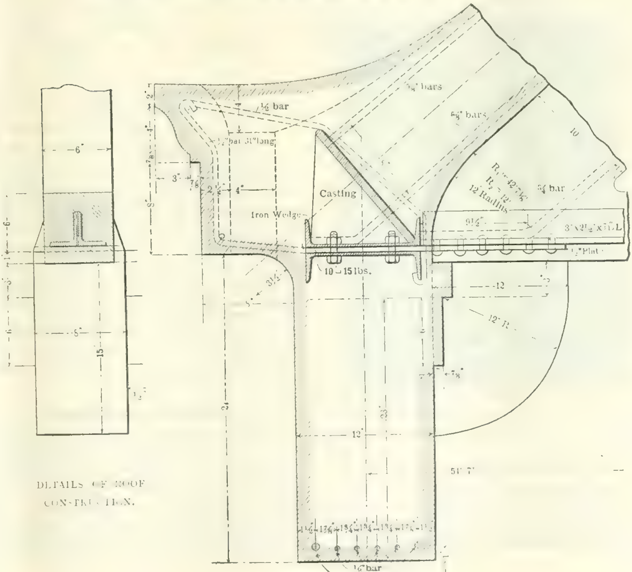




DETAILS OF CRANE RUNWAY FOR 30-TON CRANE.



TAYLOR AND WILSON MACHINE SHOP, MCKEES ROCK, PA.—CROSS SECTION.



DETAILS OF ROOF CONSTRUCTION.

crane girder. The girder was designed for a 5-ton crane, and spans 20 ft. between the circular columns. In section, the beam is 18 by 36 in., and has an upper flange. This upper flange takes care of the thrust due to the cross travel of the crane.

REINFORCED CONCRETE AND MODERN SHOP CONSTRUCTION.

We illustrate the reinforcement, practically in the form of a continuous Pratt truss running over the columns. The bars are in the forms of loops bent up at the ends to take care of the shearing stresses. The advantages of this loop are that it is self-supporting and utilises the material economically. While a great deal of metal is necessary at the centre of the span to take care of the tension, due to bending moments, these bending stresses decrease toward the supports and the same metal section is not required at the bottom of the beam, so it is utilised to take care of the shearing stresses. For suporting the rods and keeping them spaced properly and away from the form a little device stamped from sheet-metal is used. This spacer is notched out and parts bent down to support it, leaving openings to receive the bars. It was found to be far better than any system of concrete block support for the reason that it held the bars rigidly in their proper position.

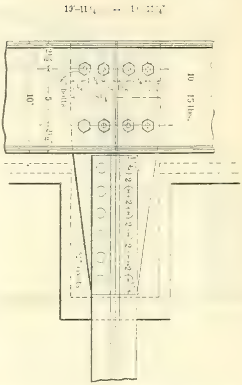
ARCH DESIGN.

Covering the main aisle—spanning 54 ft.—a concrete arch was constructed 4 in. thick at the crown and 10 in. at the haunches.

Our illustration shows the arrangement of steel in arch. This reinforcement consists of $\frac{5}{8}$ in. bars 9 in. on centres, running across the arch. Running up and down the roof, laced between the $\frac{5}{8}$ in. bars are a number of strips of band iron, 1 in. by $\frac{1}{8}$ in., arranged so that in case the rods at the intrados and extrados act in compression there will be no danger of bucking. This design was based upon the elastic theory, using Cain's method.

DESIGN OF THE HAUNCHES.

To take care of the thrust of the arch—tie-rods made up of two 3 in. by $2\frac{1}{2}$ in. by $\frac{7}{16}$ angle iron were used, spaced 10 ft. apart. These tie-rods were bolted to two 10 in. 15 ft. channels back to back, shown in figure. The channels distributed the load due to the

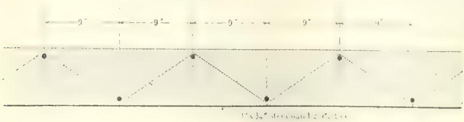


DETAILS OF ROOF CONSTRUCTION—PLAN.

thrust between the rods. A light skew back casting was placed in the upper channel to act as a spacing member for the roof rods and to transfer the loads to the tie-rods. To take care of the uncommonly large temperature stresses that would naturally be developed in such a large thin area, expansion joints were made every 10 ft. in the arch. The entire arch was constructed during the coldest winter months. Although winter construction in concrete is not commonly considered good practice among engineers, the writer considers that cold weather is the most advantageous time to handle this class of work. The reason for this statement is that when temperatures are low the aggregates of concrete are of the smallest volume, and contraction due to temperature stresses is seldom found on work carried out in the winter. Cracks seldom develop from expansion—almost entirely from contraction.

PROTECTION FROM FROST.

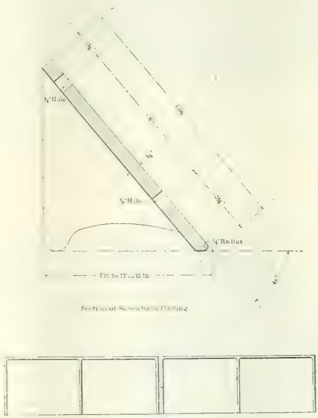
It was necessary to adopt some heating system to prevent the work from freezing during winter construction. A system of heating by live steam was installed; any system for heating concrete work that does not provide moisture as well as heat should not



be considered. It is absolutely essential that concrete should not be forced to take its set quickly. Concrete that is reinforced with steel should not be protected from freezing by the use of salt. The reason for this is obvious—salt and air corrode steel quickly, and concrete, especially concrete placed in the winter, is liable to be somewhat porous, and air will get in. The heating system by means of live steam jets was very satisfactory, and no bad effects were experienced from frost.

REINFORCED CONCRETE AND MODERN WORKSHOP CONSTRUCTION IN GENERAL.

On the front elevation of the building, the concrete mouldings about the arch windows and the cornices



SCREWBACK CASTING.

are tinted to a dark red colour that has a very pleasing effect to the eye in combination with the dull grey of the concrete.

The side elevation is almost entirely taken up by windows. The light inside the shop is nearly as good as out of doors.

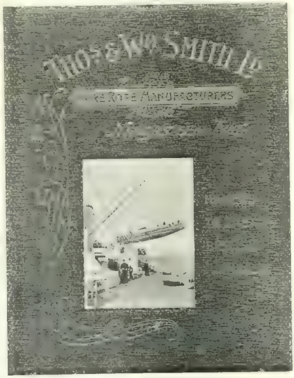
The unit cost of this work was approximately $3\frac{1}{4}$ cents per cubic foot. The building as completed is as near fireproof as is possible in any style of construction to build. As for repairs, it will need none. Paint is unnecessary on its surface to protect from the elements. The insurance rate made by the Board of Fire Underwriters is 30 cents per 100, and it is considered by them to be the best risk in the Pittsburg district.

The works were designed and built by Robert A. Cummings, M.Am.Soc.C.E., under the direct supervision of the writer.

Read before a meeting of the American Society of Mechanical Engineers.

CATALOGUE COVER DESIGN.

THE cover illustrated below is designed for a catalogue de luxe describing the wire-rope manufactures of Messrs. Thomas and William Smith, Ltd., of Newcastle-on-Tyne. The lettering, etc., is executed in gilt on a blue cloth ground and the photograph in panel shows a picket boat being hoisted on board



H.M.S. *King Edward VII.* From the letterpress we learn that extra special flexible plough steel ropes supplied by the company are in use for this purpose, the breaking stress being 85 tons.

Messrs. Cammel, Laird and Co., have dispatched the first of the armour plates required at Portsmouth for the *Invincible*.

THE CONVERSION OF OLD LATHES FOR HIGH-SPEED CUTTING.

BY GEORGE ADDY, SHEFFIELD.

THE introduction of high-speed steel, which enables tools to be run at twice or three times their former rate, has created much discussion in engineering shops as to the suitable disposal of old lathes. In very many cases, in fact, in the majority of machines, a lack of the necessary strength and rigidity has resulted either in "scrapping" the old lathes and buying new ones specially built for high speeds, or continuing to run at speeds very much below what could otherwise be accomplished.

CONVERSION OF AN OLD 30-IN. CENTRE LATHE.

The reluctance to sell for an "old song" a lathe which originally cost hundreds of pounds, can be easily understood, and it is not surprising to find that many engineers are strongly in favour of conversion. A successful instance of this is shown on the opposite page, an old 30-in. centre lathe having been converted by Mr. George Addy, of Sheffield, into an up-to-date high speed lathe.

The bed, saddle, and loose headstocks of most lathes are suitable for being utilised as high-speed lathes. It is always in the fast headstock where the weakness is found, and in the lathe under notice the course adopted was to discard the old fast headstock and fit a new and very powerfully-geared headstock to the bed, thus converting the old lathe into a really powerful modern tool, and obtaining twice the cutting speed previously possessed.

The fast headstock, which is of very massive proportions, weighs $6\frac{1}{2}$ tons, and is driven by a four-speed cone. The large speed is 36 in. diameter and the width of speeds is $7\frac{1}{4}$ in., so that belt power is not lacking, and when the gearing is examined it will be seen that no pains have been spared to turn out a headstock capable of effecting a very great economy in time when using high-speed steel. The wheels on spindle are of 66 and 33 teeth, $1\frac{3}{4}$ in. pitch, gearing into similar wheels in first gear. In the second gear a 31-wheel 2 in. pitch gears into a 40-wheel, whilst in the third gear a pinion 14 teeth $2\frac{1}{4}$ in. pitch, gears into large internal wheel on back of face plate with 94 teeth.

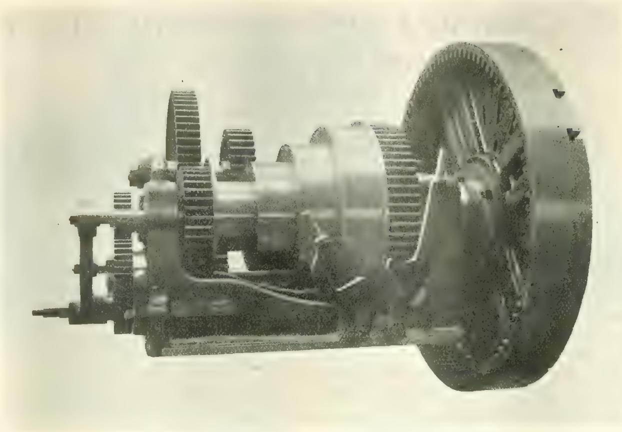
GEAR CONTROL

The two levers shown on front of headstock are for altering the gears as required, and are formed of such a shape that it is impossible to have both gears in at the same time, for one lever pushes the other out of gear, and thus all possibility of breakages of teeth is avoided.

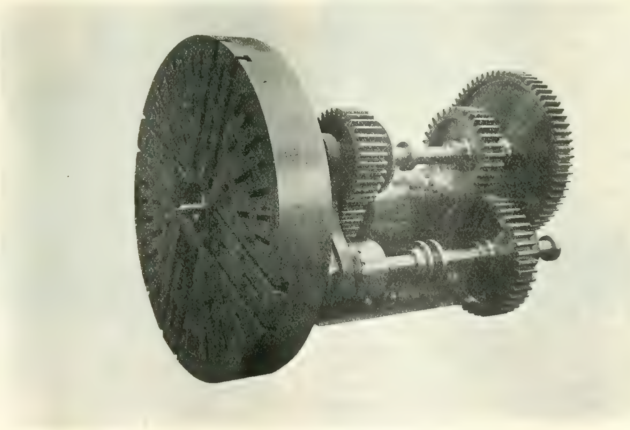
By having two sets of pulleys on the countershaft, it is possible to obtain 24 spindle speeds; twelve are obtained by the manipulation of the two levers in front of headstock, and twelve by the two sets of pulleys on the countershaft.

With such a range of spindle speeds, it is possible to obtain a cutting speed on turning tool from 15 ft. to 120 ft. per minute.

All the wheels (except the internal wheel) are machine-cut to ensure smooth running. Mr. Addy also makes on the same lines, smaller high-speed fast headstocks, down to 10 in. centres.



NEW HIGH-SPEED HEADSTOCK BY MR. GEO. ADDY, M.I.MECH.E.



BACK VIEW OF HEADSTOCK.

THE CHARING CROSS COMPANY'S CITY OF LONDON WORKS.

By W. H. P[illegible].

([illegible] 25[illegible])

SWITCHBOARDS.

THE [illegible] mains are brought to the [illegible] chamber underneath the switchboard platform, and are there connected through oil fuses to the ring [illegible]. Each motor is connected to the [illegible] through oil fuses and a Siemens and Halske [illegible] type switch which are also fixed in the E.H.T. chamber. The switches are controlled positively by levers from the machine operating panel on the switchboard platform above.

Each motor-generator has its own standard panel complete. Main switches, ammeters, voltmeters, also field switches and ammeters, are provided for both the motors and generators.

A synchronising gear of voltmeter and lamps combined is provided for the synchronous motors, and the motor field switches are omitted on the panels for induction machines.

The synchronous motors are all started up from the generator side, and the starting switch is used as the main switch for one pole of the generator, while the induction motors can be started alternatively from the generator side or from the motor side, and are fitted accordingly.

MOTOR-GENERATORS.

Induction motors are preferred in some quarters because they can be started up more quickly, and it is believed that in the event of an accident they will maintain their load better than synchronous machines, which, however, are preferred by some engineers because of their better power factor. The regulation of the direct-current side can be managed equally well with either type of machine under normal conditions.

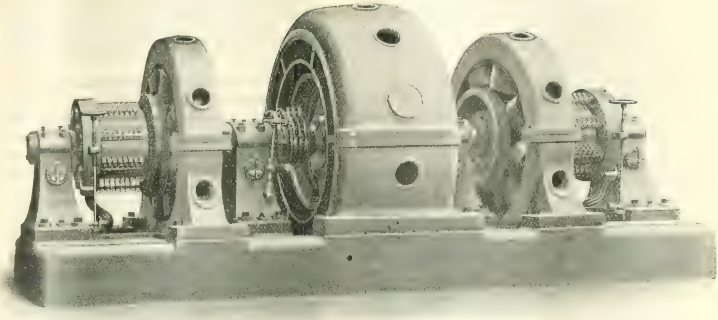
Rotary transformers have their strong advocates. For tram and railway work they are used largely of the fixed ratio type. Modifications of this type to give a variable pressure are more novel, but have been largely made by Messrs. the A.E.G. for the Berlin works. There are also other patents by Messrs. Lahmeyer and Mr. Lacour for variable ratio rotaries.

The small size of a rotary transformer as compared with a motor generator is very striking and seems much [illegible], but it must be remembered that the necessary transformers are, like the condensers [illegible] turbo-generators, generally out of sight in [illegible] basement and the mind, if not the eye, must grasp them both together.

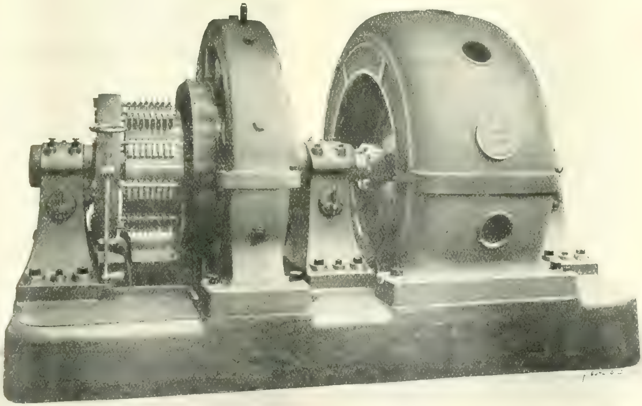
It is stated that rotaries will give a higher efficiency, but from any records that the author has been able to obtain of the practical working of the machines the regulation, although good enough for a power load, is not usually sufficiently good for a high-class lighting load.

	[illegible]	[illegible]
ALTERNATING CURRENT MOTOR [illegible]		
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible] revolutions per minute	[illegible]	[illegible]
Voltage, phases and cycles	[illegible] 3 ph., 50 cycles	[illegible]
[illegible] diameter of frame	[illegible]	[illegible]
[illegible] iron core	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
W[illegible]	[illegible]	[illegible]
N[illegible] per pole and phase	[illegible]	
[illegible]		
Diameter [illegible] flywheel over [illegible]	[illegible]	—
Outside diameter [illegible]		[illegible]
Number of poles	2	[illegible]
Type	Solid mild steel bolted to wheel	—
Winding	Wire	Bar winding in sets with slip rings
CONTINUOUS CURRENT MOTOR [illegible]		
Material [illegible]	Steel	C[illegible]
Outside diameter of yoke	[illegible]	[illegible]
L[illegible]	[illegible]	[illegible]
W[illegible]	[illegible]	1' 1½
Number of poles	[illegible]	[illegible]
Type	Solid, with mild steel laminated pole-shoes	Solid, mild steel laminated pole-shoe
Radial depth of poles	[illegible]	[illegible]
Winding	Wire	Wire
[illegible]		
Voltage and amperage	[illegible]	[illegible]
[illegible] diameter	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible] laminations	[illegible]	[illegible]
N[illegible]	[illegible]	[illegible]
Winding	Series Parallel	Parallel
[illegible]		
D[illegible]	2' 6¾''	[illegible]
Length	9¾''	[illegible]
Number of segments	384	[illegible]
	Equalising connections	Equalising connections
B[illegible]	[illegible] sets of 6 carbons	[illegible] sets of [illegible] carbons

PARTICULARS OF MOTOR GENERATORS.



LAHMEYER'S INDUCTION MOTOR-GENERATOR.



LAHMEYER'S SYNCHRONOUS MOTOR-GENERATOR.

SYNCHRONOUS MOTORS SELECTED.

After investigating the types of rotaries then available, and considering the respective merits of synchronous and induction motors for the particular case, the choice fell upon synchronous motors for the majority of the machines with one or two induction motor sets in each substation. In all cases the motors are wound for the full pressure of 10,000 volts, with a uniform size of motor of 500 h.p. and a speed of 300 revolutions per minute.

Extreme solidity of construction was called for and heavy insulation to ensure freedom from interruptions either mechanical or electrical. The results have so far quite realised the highest expectations. As so much, in fact, everything, depended on the smooth running of these machines the author did not feel justified in experimenting with light high speed machines, and it will be very interesting to see whether the result of working some of the higher speed and lighter machines now being made is equally satisfactory.

The motors in some cases drive 350 kilowatt-generators wound for the full pressure, 400 to 440 volts, across the "outer" wires, and in some cases they drive two generators each of 175-kilowatt capacity, which are wound for 200 to 220 volts, and are used as balancers on the three-wire system.

The table on page 1383 gives the leading particulars of each type of machine.

The batteries at Fenchurch Street at present comprise [illegible] cells, each of 4,000 ampere hours' capacity at a four-hour rate, made by Messrs. The Tudor Accumulator Company. The overall dimensions of each cell are 24 in. by 48 in. by 45 in. high, and its weight in the working order is 3,000 lb.

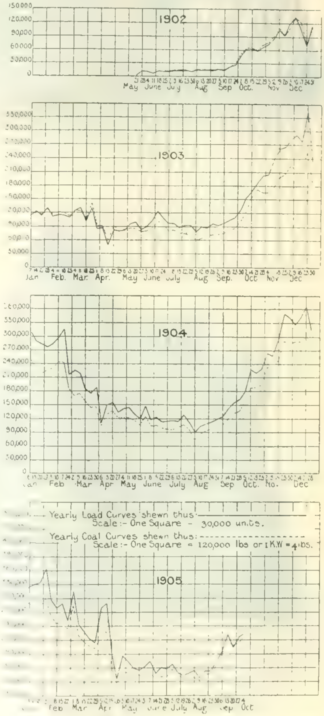
In accordance with the author's standard custom for several years, end-cells are not used, their place being taken by reversible boosters.

GENERAL WORKING RESULTS.

The Bow plant began to run in May, 1902. We show on this page the weekly output of B.T.U. generated and coal used; it is interesting, as it indicates the value of the plant more truly than any other tests. The units and coal are plotted on a 1 to 4 scale, and it will be noticed that almost throughout, the coal used is less than 4 lb. per unit. The coal used at first was large Welsh, but in the second half of 1904 small Welsh began [illegible] gradually increasing quantities and through the winter not much more large coal was used [illegible] necessary for lighting the fires, and a little [illegible]. During the year 1905 the quantity of large coal used has been infinitesimal.

The substitution of oil switches for the chimney-type switches in the generating station rendered the retention of fuses there unnecessary, but this type of oil fuse is now being used throughout the substations.

Previous inquiry as to the procedure with three-phase underground lines, none of which were working at more than 6,000 volts, and also with overhead lines at higher pressures, showed generally that no particular care was taken in switching the cables in or out; but the author was not satisfied that the plant



[illegible] PLANT OUTPUT IN K.W. AND COAL CONSUMED.

herein described, comprising large machines and long underground cables, could be worked at 10,000 volts without special precautions; he therefore arranged for a complete oscillograph investigation to be made by Mr. W. Duddell.

OSCILLOGRAPH INVESTIGATION.

The general scheme of the tests was first to take the pressure curves of the generators under steady running conditions with the station busbars only energised. Further curves were then taken of the machines running on one and more feeders, and also of the pressure between the cores of a cable when only some of the cores were connected to the busbars, the neutral point, as usual, being connected to earth. The curves taken under steady conditions were obtained on photographic plates.

The research was continued by investigation as to what occurred during switching when the records were taken on films. Preliminary switching tests were made at 5,000 volts, that is, half normal working pressure, when the maximum volts were found to be about twice the normal

RESULTS OF EXPERIMENTS.

The result of the experiments was to show that resonance was more likely to occur if the periodicity was varied, and that, therefore, it was dangerous to switch a cable in at a low frequency and then run up to normal speed on the cable, and that the safer procedure was to switch it on the normal frequency with low volts and then raise the pressure.

It was then further shown that under working conditions, in the event of a circuit being opened through, for instance, the action of a fuse, a surge was likely to occur, and that it would be safer to provide spark-gaps. A spark-gap in itself, although a safety-valve for a surge, may start a rush of current which will cause further surges. The use of spark-gaps as

1,000 k.w. Generator energising 1 Feeder.
The Oscillograph was connected between Cores 2 and 3 of Feeder.

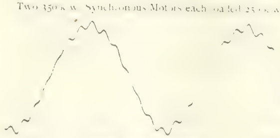
Only Core No. 1 connected to Generator.
No visible P.D. between Cores Nos. 2 and 3.

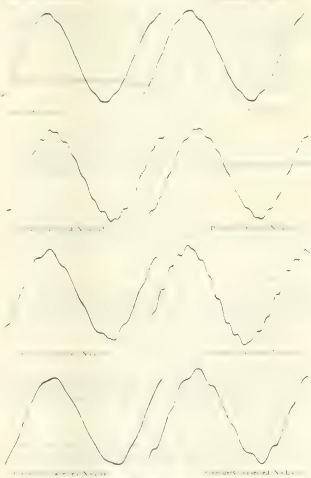
Only Core No. 2 connected to Generator

Core No. 1 and 2 connected to Generator

Station Busbar Wave-form at times of Light Load.
500 k.w. Machine 2 Feeders connected.
One 350 k.w. Synchronous Motor Loaded 25 ...

Two 350 k.w. Synchronous Motors each loaded 25 ...





OSCILLOGRAPH TESTS AT LOW GENERATING STATION

a remedy ... may easily be worse than the disease. It is therefore very important to carefully consider the amount and form of resistance to be used in series with them. The common form of horn-type spark-gap was experimented with and abandoned in favour of a spark-gap which has carbon on the one side and copper on the other. The travelling of the spark up the parallel portion of the horns is increased by the chimney action of the glass enclosure, and the result of many tests has been to show that they may be calibrated and set with much greater accuracy than the ordinary bent wire horn type.

As regards resistances, a non-inductive type must of course be used, and after many experiments an extended trial was given in the form of liquid resistance, which consists of earthenware vessels filled with a solution of glycerine and water. What at first appeared to be unaccountable changes took place in some of the resistances; investigation showed that they were due to the action of sodium or other salt in the air. Alternative solutions have also been tried with sodium in them which were found to be more constant.

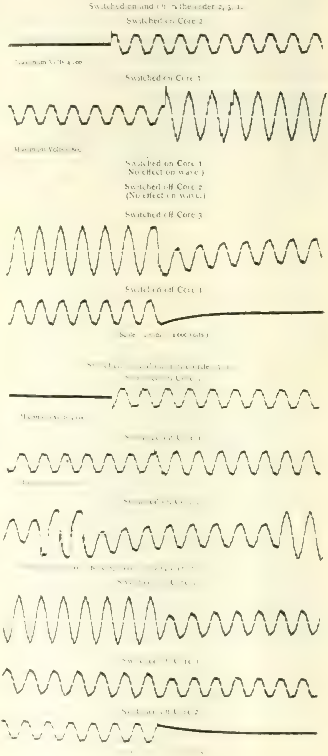
DRY RESISTANCES.

Further experiments have been made and are still being made in the direction of dry resistances, as, no matter how good it may be, a liquid resistance always has the disadvantage that it is liquid and may leak. Attempts to obtain rods made of graphite mixture have not up to the present been successful, and forms of pressed graphite contained in cylinders, which, though satisfactory for low pressures, have not yet proved reliable for high pressures. In view of the amount of high-pressure plant now being made, the author hopes that manufacturers will give attention to this detail, and produce a high resistance of small bulk which can be relied on under working conditions. The width of spark-gap employed is 4·5 millimetres for 10,000 volts working pressure, *i.e.*, 5,800 volts between each phase and earth with the centre of the star earthed. A spark will jump the gap at 12,000 volts when the horns are clean and the atmosphere normal. Occasional and irregular working of the spark-gaps soon attracted attention, and the author determined to try and find out the causes which resulted in these ... interruptions cause surges all over ... system.

The subject of surges is a very interesting one, and the author hopes it will be taken up in other quarters, and that such data may be forthcoming as will throw light on ... the unexpected incidents that happen ... working ...

WAVE FORMS AND RESONANCE.

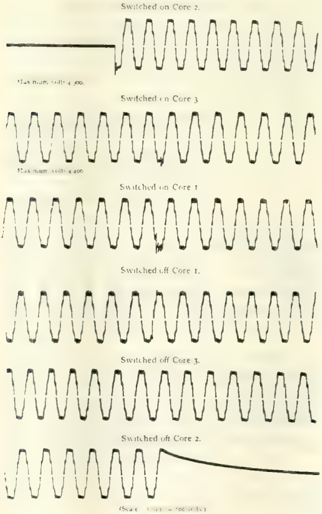
The accompanying wave forms taken with those already given for the 800-kilowatt generator, show the effect of increasing the load from 0 to 500 kilowatts on one of the small sets. The wave-form with a load of 250 kilowatts is very similar to that obtained when there was no load at the end of the feeders; the last curve with 500 kilowatts is a little more irregular.



As the wave forms are very satisfactory in shape under all the conditions examined, it remains to consider the possibility of dangerous conditions arising due to different arrangements or to future extensions. With the 1,600-kilowatt machine there is a tendency to a resonance of the 13th harmonic with 3 City feeders, and to a resonance of the 11th harmonic with 4 City feeders; that is to say, with a capacity of 3 feeders the circuit formed by the generator and feeders has a free frequency of 650 ∽ per second, and for a capacity of 4 feeders 550 ∽ per second. Reducing this by Kelvin's law the free frequency would be [illegible] ∽ per second for 1 feeder.

The resonances which may be dangerous are those of the fundamental, the 3rd (the 3rd harmonic exists between one terminal and the neutral point) and 5th harmonic. In order to obtain a resonance of the fundamental, which would be very troublesome and dangerous, the product of the self-induction into the the capacity would have to be 484 times as large as with one feeder and one 1,600-kilowatt machine. The self-induction of the 800-kilowatt sets is probably double that [illegible], so that for resonance of the fundamental with a 800-kilowatt set about 240 times the capacity of a City feeder would be required; this is never likely to occur. The resonance of a 3rd harmonic is also for the same reason unlikely. A resonance of the 5th harmonic would require 19·4 times the capacity of a City feeder with a 1,600-kilowatt set; and 9·7 times with an 800-kilowatt set. This could, therefore, occur with the present plant, though it is not likely that nearly all the feeders will ever be connected to an 800-kilowatt set at times of light load.

If at any time it is proposed to energise one or more of the feeders by means of any apparatus having a high self-induction, such as a very small alternator used with or without transformer, it is necessary to take great care that the self-induction does not have such a value as to make it possible to have a dangerous resonance of the fundamental or one of the lower harmonics. It is to be noted that larger generators than at present installed will probably have less self-induction, and will therefore be, if anything, less liable to produce resonances; also several generators in parallel behave as if they had less self-induction than one machine. It appears, therefore, that as far as resonances are concerned, the plant is very free from dangers.



SWITCHING TEST AT 5,000 R.M.S. VOLTS.

800-kilowatt generator, switched on and off Cannon Street feeder on open circuit recording wave-form of P.D. between cores Nos. 2 and 3.

Frequency 50 ∽ per second.

The cores were switched on and off at one time. There are many wave-forms omitted between one print and the next.

As might be expected, the highest P.D.'s are recorded when the oscillograph is connected between the first and second cores which are switched on. The highest instantaneous value of the P.D. recorded was 9,800 volts, or nearly twice the R.M.S. value (5,000), so that it should be just safe to switch on a feeder on open circuit at 10,000 R.M.S. volts; if the insulation will stand 20,000 R.M.S. volts, this would give a margin of safety of about 40 or 50 per cent.

The oscillations which occurred between the self-induction of the generator and the capacity of the feeder are very high frequency, and die down so quickly that it is difficult to estimate their frequency with any accuracy. Measurements on the films make the frequency about 750 ∽ per second, and this is in accordance with the value one would expect deduced from the tendency to give resonances under

[illegible] which have [illegible] been noted.

See kilowatt generator switched on, and off Central Street feeder on open circuit recording wave-form of P.D. between Core No. 2 and earth. (Lead.)

Switched on cores in the order 2, 3, 1. Switched off in the order 1, 3, 2. Further wave-forms are given in figure.

Any sudden change of voltage on the cable, or of current through the machine, will tend to set up oscillations whose amplitude will be the greater the less the losses in the system, so that any sudden changes in P.D. or current, especially when a cable is on open circuit, are dangerous. Thus it is dangerous to switch on an unloaded feeder or to switch off, or remove by a fuse, a very heavy load or short circuit if by so doing any unloaded or lightly-loaded feeder is left connected to the generator. Added to the high P.D.'s produced by these oscillations, which do not seem to exceed three times the R.M.S. value, there are the much higher P.D.'s which can be set up when any unstable arcs or sparks occur in the circuit.

It is most important to avoid any arcs or sparks of any sort whatever occurring in the circuit, or they probably produce sufficiently high voltages to break down the insulation. The breakdown of the insulation in a single place generally produces an arc or spark there, which in its turn aggravates the evil, producing still higher voltages and further damage. Thus a single tiny arc or spark may lead to the breakdown of a lot of valuable plant and cause an interruption of supply. As it is necessary to be able to switch in and out feeders without shutting down the station, charging gear was provided for the purpose.

Abstract of Paper read before the Institute of Electrical Engineers.

THE LABOUR MARKET.

BOARD OF TRADE statistics show that employment generally continued to improve in November, the most noticeable improvement being in the pig-iron, iron and steel, tinplate, and engineering trades. As compared with a year ago, there was a general improvement in employment, except in the building trades, which, on the whole, were about the same. The most marked improvement was in the metal, engineering [illegible] trades.

Employment in the pig-iron industry during November continued good, being better than in the previous month, and much better than a year ago. Returns received relating to the works of 108 iron-masters [illegible] furnaces, employing about 23,700 workpeople, were in blast at the end of November—four furnaces more than in October, and 31 more than a year ago. The number of furnaces now in blast is greater than in any month since November, 1900.

Districts.	Number of Furnaces, included in the returns, in Blast at end of			Increase (+) or Decrease (–) in Nov., 1905, as compared with	
	Nov., 1905.	Oct., 1905.	Nov., 1904.	A month ago.	A year ago.
ENGLAND & WALES—					
Cleveland	86	87	77	– 1	+ 9
Cumberland & Lancs	37	36	32	+ 1	+ 5
S and S W Yorks	16	16	13	...	+ 3
Derby & Nottingham	38	38	36	...	+ 2
Leicester, Lincoln, and Northampton	28	28	25	...	+ 3
Stafford & Worcester	35	34	30	+ 1	+ 5
S Wales & Monmouth	14	14	15	...	– 1
Other districts ...	7	7	6	...	+ 1
Returned from England & Wales	261	260	234	+ 1	+ 27
Returned from Scotland	74	71	70	+ 3	+ 4
Total furnaces included in returns	335	331	304	+ 4	+ 31

PIG IRON RETURNS.

Employment at iron and steel works continued brisk; it was better than a month ago, and considerably better than a year ago, the number employed in 199 works from which returns have been received being 777 greater than a month ago and 8,604, or 10·1 per cent. greater than a year ago.

	Number of Workpeople employed by firms making returns			Average Number of Shifts worked per man		
	In week ended Nov 25th, 1905.	Increase (+) or decrease (–) as compared with A month ago	Increase (+) or decrease (–) as compared with A year ago	In week ended Nov. 25th, 1905.	Increase (+) or decrease (–) as compared with A month ago	Increase (+) or decrease (–) as compared with A year ago
Departments.						
Open Hearth Melting Furnaces	8,555	+ 244	+ 1,082	5·88	– 0·02	– 0·04
Crucible Furnaces	558	+ 22	+ 63	5·38	– 0·18	+ 0·49
Bessemer Converters ..	1,628	– 4	– 5	4·91	– 0·09	– 0·10
Puddling Forges	10,026	– 162	+ 251	5·11	– 0·03	+ 0·31
Rolling Mills	30,486	+ 89	+ 2,164	5·40	– 0·02	+ 0·24
Forging and Pressing ..	3,979	+ 56	+ 618	5·61	– 0·04	+ 0·17
Foundries	12,061	– 120	+ 1,492	5·83	– 0·01	+ 0·08
Other Departments	9,808	+ 270	+ 1,576	5·84	– 0·01	+ 0·10
Mechanics, Labourers .	16,849	+ 382	+ 1,413	5·87	+ 0·01	+ 0·14
Total	93,880	+ 777	+ 5,6[illegible]4	5·60	– 0·01	+ 0·18
Districts.						
Northumberland & Durham	11,840	+ 79	+ 656	5·63	+ 0·03	+ 0·25
Cleveland ...	8,737	– 11	+ 726	5·75	+ 0·08	+ 0·13
Sheffield and Rotherham ..	17,665	+ 136	+ 2,290	5·66	0·03	+ 0·14
Leeds, [illegible] and other Yorkshire Towns	4,745	+ 3	+ 572	5·64	..	+ 0·44
Cumberland, Lancs & Ches	9,611	– 70	+ 121	5·29	– 0·29	+ 0·25
Staffordshire ..	10,358	+ 2	+ 730	5·5[illegible]	+ 0·09	+ 0·16
Other Midland Counties ...	4,430	+ 54	+ 463	5·47	+ 0·03	+ 0·07
Wales and Monmouth ...	9,412	+ 156	+ 1,249	5·69	+ 0·02	+ 0·05
England and Wales ..	76,301	+ 345	+ 6,747	5·59	0·01	+ 0·18
Scotland	17,579	+ 432	+ 1,857	5·64		+ 0·16
Total	93,880	+ 777	+ 8,604	5·61	– 0·01	+ 0·1[illegible]

[illegible]ENT IN THE IRON AND STEEL INDUSTRY.

TECHNICAL SOCIETY NOTES.

LAST Thursday, at the Institution of Electrical Engineers the central station officers had a field night. Mr. Patchell's paper on the Bow station equipment had by no means appeased the appetite for information. Central station engineers came from all parts of the compass in an Oliver Twist mood, and asked Mr. Patchell to tell them a great deal more than he had done in the printed paper. A good deal of free but friendly criticism was also meted out. Mr. Sparks, who in a parliamentary sense had moved the adjournment at the previous meeting was first to catch Mr. Gavey's eye. He referred again to the question of coal-consumption, pointing out that the figure of something under 4 lb. per unit referred to by Mr. Patchell, was at the main generating station at Bow. He thought it would be interesting if Mr. Patchell would state what was the coal consumed per unit at the sub-stations where the energy was utilised.

Mr. J. S. Highfield continued the discussion, and emphasised the great advantage of three-phase over two-phase working for long-distance transmission. With regard to the deterioration taking place in the insulating material of alternating coils, which Mr. Patchell seemed to think was due to bad material, he had made the matter the subject of very careful research, and was of opinion that it was due to the formation of nitric acid from the atmosphere. Mr. Booth naturally dealt with boiler problems. In this respect he said that he thought the Bow station was not quite up to date, and he aired his pet theories as to heating of feed-water, and the forming of steam in stages. The boiler, made to do all kinds of work should, he urged, merely do the duty of evaporating the water and not heating it Only in that way, could the best possible economy in the engines be obtained. He complained that the boilers were not designed for burning bituminous fuel.

Mr. J. H. Rider, the electrical engineer to the London County Council, said that the distribution being by direct current, the use of rotary transformers was necessitated, and that being so he considered 25 cycles per second would have been a more suitable periodicity. He praised the system of double grates, but would like to have seen mechanical stoking adopted. Mr. Patchell apparently believed in synchronous machines, but he, after extended experience, preferred induction [illegible], he believed in simplicity, which made for commercial efficiency. Mr. Patchell could add largely to the value of his paper by giving figures as to the cost of power house and cost of operation. Electrical engineers wanted to know the capital cost per kilowatt, with some details as to cost of coal per ton, and information as to load factor. This information would be more valuable than the paper itself.

After Mr. Venning and Mr. Anstey had discussed the merits of different makes and types of boilers, Professor Epstein came to the support of Mr. Patchell. Then came Mr. W. M. Mordey, who dealt with the deterioration of insulation materials under alternating high pressures and promulgated a theory of his own. It had occurred to him that the action which produced this effect, might be mechanical, rather than chemical or electrical. The cause he suggested was the hammering on the insulating material due to the static attraction between two conductors. He also commented on the way in which electrical engineering involved the solution of purely engineering problems of very great importance Mr. H. M. Sayers put in a plea for mechanical stokers, and discussed some of life's little worries as exemplified in the daily work of a central station engineer.

The discussion at the Institution of Mechanical Engineers on the seventh report of the Alloys Research Committee's dealings with iron-nickel-manganese-carbon alloys took a very curious turn, the authors having widely disagreed among themselves as to the tests made. Two of the authors, as Professor Arnold expressed it, spent a good deal of time in discussing the third, and the situation was, therefore, distinctly Gilbertian. Dr. Carpenter is certainly at variance with Mr. Hadfield and Mr. Longmuir, as to what has to be deduced from the experiments, and his conclusions were attacked by no less an authority than Professor Arnold in a powerful speech. It was urged that the cooling curves obtained at the National Physical Laboratory on the differential method were unreliable. Any apparatus, claimed Professor Arnold, ought to bring out the relative value of the points A.R. 1, A.R. 2, A.R. 3. In the National Physical Laboratory's curves these points were mingled and confused. Moreover, the curves showed decided traces of the existence of oxygen, which destroyed their value. He fancied it would be found that there was

[illegible] direct contact with the metal, and moreover the operations were carried out in air. At Sheffield University, the cooling was done in vacua, and a point was made of securing the proper contact to obviate the slightest suspicion of lag.

Professor Arnold next proceeded to tilt at the National Physical Laboratory and its work. Everybody, he said, was anxious for the success of that Institution, but he thought it would have been an advantage had more attention been given to the work of those who have been engaged in these investigations for twenty-five years, and whose experience was at its disposal. [illegible] alloy K with [illegible] per cent. [illegible] an extraordinary theory was put forward. If the curves given in the paper showed the critical range of this alloy, it should be magnetic, because a change marked by a deviation from the vertical had taken place. If that took place in the nickel, it must have taken place in the iron. As a matter of fact, a sample of K forged was absolutely non-magnetic, but cooled in liquid air was strongly magnetic, the change point being about 80 deg. below zero. In a previous paper, Dr. Carpenter had said that there was no change down to 500 deg. C, but in this paper he showed a change in the nickel taking place at 646 deg. C, which meant a discrepancy of 146 deg.

It was claimed, said Professor Arnold, that the results obtained in this research were in perfect agreement with those arrived at by Monsieur Guillet. The nickel steels were divided into three groups, pearlitic, marensitic, and polythedral. This classification was inherently almost impossible, the members of the different groups being often practically indistinguishable from each other. Pearlite itself was essentially polyhedral. Looking at the photo-micrographs in the paper, on which the statement as to agreement with Guillet was founded, he was bound to say he could see no essential difference in the structures, and so far from the research having confirmed Monsieur Guillet's researches, he contended that it had done exactly the opposite. Put briefly, his deduction was that the micrographical investigation had thrown very little light on the matter. As to the allotropic theory in connection with the properties of iron and nickel steels, Professor Arnold asked that judgment should be suspended. That is probably a very mild way of stating his real opinion. The attack on the deduc- [illegible] Professor Arnold, although Mr. Hadfield uttered a warning as to drawing conclusions from the tests. Mr. Longmuir was much more emphatic, disagreeing almost as entirely with the conclusions stated in the paper as did those critics who were not joint authors with Dr. Carpenter. In particular, he appeared doubtful of the Guillet classifications and recognised the vitiation of the cooling curves by the presence of oxygen. Professor Gowland was almost the only speaker who praised the paper, which, he stated, was, in his opinion, an excellent piece of work, although even he regretted the fact that the tests were not duplicated, and drew attention to the very small sections used for the mechanical tests. Professor Barrett came over from Ireland mostly to generally complain that the work of Irish men of science was not properly appreciated in this country. He particularly called attention to the omission of the authors of the paper to refer to the work done by Professor Barrett himself in a portion of the field covered by the paper. Next Mr. Wingfield referred to the experimental errors likely to arise from merely bending and not breaking specimens in the impact tests, and finally came the turn of Dr. Carpenter.

He stood up boldly to his many critics, but dealt mainly with Professor Arnold's points. Professor Arnold, he said, had attempted to discredit the result of the cooling curve experiments, and had impeached the method in use at the National Physical Laboratory. Professor Arnold's method of taking cooling curves was one introduced by Osmond, who himself admitted that it was not sufficiently delicate for the investigation of the small thermal transformations of nickel steels, and had stated that Roberts-Austen's differential method could be applied with great advantage in such cases. The method in use at the National Physical Laboratory was of this kind, and the apparatus was, he believed, the most sensitive in existence at the present time. The temperature scale was between nineteen and twenty times more sensitive than that of Professor Arnold. If, as had been urged, the presence of oxygen in the alloy, or, as it would be fairer to state, its oxidised skin, altogether invalidated the results, how did the Professor explain the identity of the cooling curve of electrolytic iron taken in a vacuum by Roberts-Austen, with that of a Swedish iron containing 0·01 per cent. carbon taken in air by the author? If, further, the author's temperature determinations were low, as was alleged, how was it that the critical ranges of iron carbon alloys given by Mr. Keeling and the author in a previous paper before the Iron and Steel Institute were higher than those found by Professor Arnold? Dr. Carpenter also defended the claim of agreement with M[illegible]

The paper on the "Behaviour of Materials of Construction under Pure Shear," read at the Institution of Mechanical Engineers last Friday, and reprinted in this issue, ought to produce an interesting discussion, for the subject is one of wide importance. Indeed, the contributions of Professor Lilly, who opened the discussion, and Professor Carus Wilson, who followed him, made it a matter for regret that the time available was so short. Professor Lilly opened a critical speech by the statement that the title of the paper itself was a misnomer. There was, he pointed out, no other way of applying what was called pure shear in a practical way than by means of a torsion test, and the author was really only dealing with shearing stresses. Mr. Izod would, thought Professor Lilly, have greatly added to the value of his paper if he had taken compressive strength at the same time. It was necessary to know the relation between the compressive strength, the shear strength, and the tensile strength, and in all isotropic materials this was generally in the order named. From the results given in the paper that statement would be at once questioned, but it was only under exceptional conditions that a shear strength less than the tensile strength was obtained. It was to be noted that from the paper it was only possible to get the value of the ratio of *Fs* to *Ft* for the particular thickness of bar tested.

Professor Carus Wilson, who followed, was able to speak on this question with the voice of one having authority. He is the author of a paper to the Royal Society dealing with experiments in confirmation of the statement by Dr. Darwin, that the only conceivable way in which a bar can be broken is by overcoming a certain tendency to shear. In testing a bar for tensional strength, there is produced incidentally a shearing stress, which, when it reaches a maximum, would be followed immediately by the rupture of the bar. The ultimate criterion of strength of any material is held by this school to be its resistance to destruction, and the acceptance of this view is followed by important results. Turning to Mr. Izod's paper, Professor Carus Wilson was of opinion that the author had minimised the importance of the problem investigated, and had really given it up as unsolvable, when, as a matter of fact, his own statistics could be used to supply a correct answer. The truth was, said this critic, that the author had fallen into the mistake of adopting an arbitrary method of estimating tensional stress. He should have taken the actual tensional strength at rupture, and measured the load at rupture on the reduced area. From that the true shearing stress at the moment of rupture, which was known to be half the maximum tensional strength, could be established, and if compared with the shearing strength obtained on the same specimens by the shearing experiments, the author would have obtained results giving absolute equality and identity.

NEWS ITEMS.

The Transvaal Institute of Mechanical Engineers have come to the conclusion—the ballot box showing seventy-two votes to forty—that the resident engineer appointed to the charge of machinery on a mine in the Transvaal should hold a Government certificate of competency.

In connection with the exhibition of smoke prevention and other appliances, Messrs. Ed. Bennis and Co., the Gas Light and Coke Company, Messrs. Meldrum Brothers, the Power Gas Corporation, and the Westminster and Pall Mall Electric Lighting Company have received special medals, while twenty-three bronze medals have been also awarded. The silver medal awarded to Messrs. Bennis was for their Mechanical Stoker and Self-Cleaning Compressed Air Furnace. The firm obtained a bronze medal for their new Chain Grate (Bennis-Miller-Bennett Patent).

The recent fire at the Spanish Dockyard, in which the two torpedo boats *Ariete* and *Rayo* were burnt, draws attention to these two vessels, which were built by Messrs. John I. Thornycroft and Co., at Chiswick, in 1887. They are of considerable interest as being the first two war vessels to be fitted with watertube boilers. They attained a speed of 26 knots, which, at the time they were built, was considered phenomenal, being several knots faster than any other vessel.

The dimensions of the two vessels were as follows: Length, 147 ft. 6 in.; beam, 14 ft. 6 in.; draft, 5 ft. 0 in.; speed, 26 knots; load, 19 tons.

The machinery consisted of two sets of compound surface condensing engines developing 1,350 i.h.p., the steam steering engine in aft compartment working twin rudders.

Two Thornycroft watertube boilers were fitted, and the equipments included electric light plant with search light. The armament consisted of two four-barrel Nordenfeldt 1-in. guns, one in conning tower forward, and the other on centre line of deck just aft of midship; two 14 in. diameter bow torpedo tubes, with two spare torpedoes stowed in well.

SHIPBUILDING NOTES.

THE Board of Trade returns for the month ended November 30th show that the tonnage of vessels entered at ports in the United Kingdom from foreign countries and British possessions, with cargoes, amounted to 3,255,150 tons, and the tonnage cleared to 4,161,313 tons, as against 3,143,856 tons entered and 4,002,738 tons cleared in the month of November, 1904. With regard to the coasting trade, the tonnage entered with cargoes during November last, amounted to 2,714,519 tons, and the tonnage cleared to 2,713,636 tons, as against 2,650,816 tons entered, and 2,634,974 tons cleared in November, 1904.

Messrs. Workman, Clarke and Co., Ltd., of Belfast, completed their output for this year a week ago by the launch from their South Yard, of a steamer for the British India Steam Navigation Company, Ltd. The *Suva*, which is a steamer of about 2,600 gross tonnage, is intended for her owner's Australasian passenger trade. Her engines are of the triple-expansion type, and steam is supplied by two cylindrical multitubular steel boilers, working at a pressure of 200 lb. under Howden's system of forced draught. The cargo space of the vessel is divided into three holds, each of these having a large hatchway equipped with two steam winches and derricks swung from crane posts.

The new passenger steamer *Moruya*, built to the order of the Illawarra and South Coast Steam Navigation Company, Ltd., of Sydney, N.S.W., and intended for the company's trade on the Australian coast, was launched recently from the Caledonian Shipbuilding Yard, Strand Road, Preston. She is 149 ft. in length by 25·6 ft. by 15 ft. 2 in. moulded to the awning deck, and has accommodation for twenty first-class passengers and will be fitted by the builders with two sets of compound surface condensing engines, having cylinders [illegible]

Closely following the Bibby liner *Herefordshire*, which recently left Messrs. Harland and Wolff's yard, the new steamer *Malakand* for the Liverpool-Calcutta service of Messrs. T. and J. Brocklebank, Ltd., of Liverpool, took her departure on Thursday last week. The machinery for this ship was constructed at Messrs. [illegible] expansion type, designed so that at full load a speed of twelve knots will be maintained at sea on a moderate [illegible] to Lloyd's special survey to class 100 A1 on the three-deck rule, and is the second of four new steamers which Messrs. Harland and Wolff have had in hand for Messrs Brocklebank. Her principal dimensions are: Length overall 484 ft. 2 in., breadth 58 ft., depth 36 ft. 3 in. Gross tonnage about 8,000 tons, and deadweight capacity over 11,000 tons, which makes her and sister ships the largest cargo steamers in the Calcutta trade.

Messrs. Harland and Wolff, Belfast, launched on the 14th inst. the steel-screw steamer *Manipur*, the third of the four steamers above mentioned which they have been constructing to the order of Messrs. T. and J. Brocklebank, Ltd. The new vessel, which is 470 ft. long, by 58 ft. beam, and about 8,000 tons gross, will have a deadweight carrying capacity of over 11,000 tons. The engines and boilers for the vessel are also being constructed by Messrs. Harland and Wolff, the engines being of the quadruple expansion type.

There was launched from the shipyard of Messrs. Cochrane and Sons, Selby, on the 14th inst., a steel screw trawler, the principal dimensions being 126 ft. 2 in. by 22 ft. by 11 ft. 6 in. depth of hold. The vessel has been built to the order of the North-Eastern Steam Fishing Company, Ltd., of Grimsby, and will be fitted with powerful triple-expansion engines, by Messrs. C. D. Holmes and Co., of Hull. As the vessel left the ways she was named the *Bromelia*.

[illegible] from the annual returns of the more important shipbuilding yards. A further instalment will appear in our next issue. As we write, the series is not complete, but there is every indication that the year 1905 will prove a record one. The Belfast shipbuilding yards show a very considerable increase on last year's output. Messrs. Harland and Wolff's ten vessels total 85,287 tons, against 31,878 last year. Messrs. Workman, Clarke and Co.'s output amounts to 64,140, represented by twelve vessels, as compared with 44,272 tons for the preceding year. The total Belfast tonnage is 149,427 tons. In addition, Messrs. Harland and Wolff built the 18,000 h.p. engines for the first-class battleship *Hibernia*, and, as our readers will remember, two of the ten vessels launched by this firm—the *Amerika* [illegible]

Compared with last year, Messrs. W. Denny and Bros'.

returns show an increase of [illegible] tons, including three turbine steamers. Messrs. John Brown and Co. have launched one more vessel than a year ago, but their tonnage is slightly less. The shipbuilding "blue riband" has been won this year by Messrs. Wm. Doxford and Sons, Ltd., whose output approximates 87,000 gross register tons. As pointed out above, Messrs. Harland and Wolff are not far behind, while Messrs. Russell and Messrs. Wm. Gray and Co. follow with 71,540 and 63,276 tons respectively.

JOHN I. THORNYCROFT AND CO., LTD.

Return of vessels launched [illegible]

No. of Boat.	Name.	Type.	Machinery.	Tonnage.	I.H.P.	Speed knots.
[illegible]	H.M.S. *Colne* ..	British torpedo-boat destroyer	4-cylinder triple expansion C.S.C.	[illegible]	[illegible]	[illegible]
[illegible]	[illegible] ..	Passenger, for Mauritius ..	Twin-screw triple expansion ..	[illegible]	470	
378	[illegible] ..	Swedish torpedo-boat destroyer	4-cylinder triple expansion C.S.C.	[illegible]	7,000	[illegible]
[illegible]		Motor yacht	Twin-screw 4-cylinder	[illegible]	216	[illegible]
397	*Firefly* ..	Ditto (British)	Single-screw 4-cylinder ..	[illegible]	108	
405	*Emil Capitaine*	Yacht (British)	4-cylinder gas producer plant	[illegible]	70	
[illegible]		Chinese tug	C.S.C.			
[illegible]	[illegible] ..	British tug, etc. .. .	4-cylinder gas producer .	17	70	[illegible]
[illegible]	—	Barge (British)	4-cylinder steam — —	7·5	[illegible]	[illegible]

In addition to the above, a large number of motor launches, for [illegible] parts of the world. This return applies to the firm's Chiswick works only.

Return [illegible]

Boat No.	Name.	Type.	Machinery.	Tonnage.	I.H.P.	Speed knots.
[illegible]	*Gadfly* ..	Coast destroyer (British) ..	Parson's turbines ..	[illegible]	3,700	[illegible]
[illegible]	*Glow-worm* ..					
[illegible]	*Gnat* ..					
[illegible]	*Grasshopper* ..					
[illegible]	*Greenfly* ..					
[illegible]	*Spider* ..	Motor canoe (Nigeria)	4-cylinder Thornycroft motor	[illegible]	[illegible]	[illegible]
[illegible]	*Sandfly* .	Stern wheel canoe (Nigeria) ..		[illegible]	35	7

In addition to the above a large number of small motor launches, etc.

WHITE AND HEMPHILL, LTD.

Vessel.	Owners.	I.H.P.	Pressure lb.	Compound or triple.
[illegible]	Murdoch and Murray ..	[illegible]	[illegible]	Compound.
[illegible]	..	[illegible]	[illegible]	
[illegible] .. .	. .	[illegible]		Twin-screw.
Wood launch .. .	Foreign	[illegible]		High-pressure.
.. . .	.. .	[illegible]		
.. .. .	. . .	80		
Various land engines ..	—	95		—
Salvage and other centrifugal pumps	—	[illegible]		
	Total ..	[illegible]		

Also large amount of repairs and general engineering

[illegible]

Marine engines and centrifugal pumps [illegible]

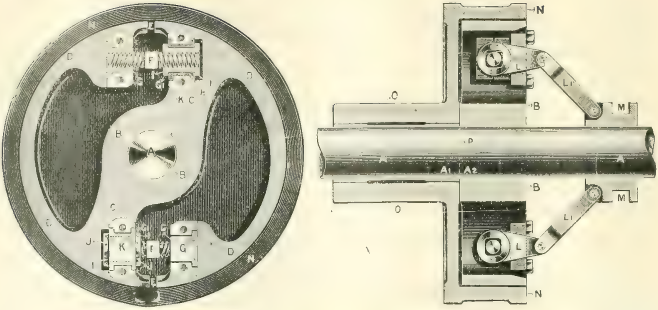


FIG. 1. HEYWOOD AND BRIDGE'S IMPROVED FRICTION CLUTCH—TYPE B.

THE FRICTION CLUTCH AS A POWER ECONOMISER.

THE illustration on page 1395 shows an interesting application of one of Messrs. David Bridge and Co.'s friction clutches used in connection with a 400-b.h.p. Diesel oil engine running at 150 revolutions per minute and driving a cotton mill.

Before referring to the installation in detail it may be well to indicate the general features of the clutches designed under Heywood and Bridge's patents, which can perhaps best be done by referring to the accompanying illustration (fig. 1) of type B, prepared for belt, rope, spur and bevel wheel driving also shaft frictional coupling.

[illegible] view and transverse section. It illustrates the friction wheel or internal part of clutch and its relative position with a shell or external part to be driven. A is a shaft or prime mover on which is keyed [illegible] B; from the boss B [illegible] two arms C and the rim D, forming the internal part of clutch, consisting of one casting. The rim D is divided transversely at E, but retains unity in consequence of the said rim D, being connected with the arms C. The sockets GG1 are cast in the rim D. In sockets G1 are placed adjustable round nuts H formed at each end with flanges I, having "tommy" holes J. The nuts H are carried in square blocks K, formed in halves, with a slight clearance between. In nuts H and K are inserted the ends of left and right hand screws F. By means of levers LL1, which are connected to the screws F, and to the sliding sleeve M, the ends of the screws F, cause the rim D to expand or contract when the sliding sleeve M is moved nearer to or further from the face of the clutch. By these operations the rim D expands when power

is required and binds upon the internal surface of external shell N, and this causes the external part N to rotate at equal speed.

In the case of the clutch illustrated in fig. 2 (type E), instead of the boss being cast to the shell of clutch as shown in fig. 1, it is made from a mild steel forging bored out of the solid, with a flange at one end and bolted to the shell. The pulley is keyed in the centre, with a bearing on either side to support the shell of clutch from the line shaft, so that the weight of the pulley and shell of clutch is taken off the shaft altogether.

As illustrated, the clutch is fixed on the mill shaft, or second motion shaft. To commence working the engine is started up at full speed driving on to the rope pulley fixed on clutch boss, the clutch, of course, being out of gear, and the shaft being also stopped on which the clutch is fixed; the clutch is then put into gear, and the mill shaft on which it is fixed is started up gradually without shock or jar, and without in any way interfering with the smooth running of the oil engine.

These clutches are now finding economical use in many situations in mills and works, where they avoid the consumption of unnecessary power in keeping the main shafting perpetually in motion, while in the event of accident it is possible to instantly stop the main shafting. Their most important feature appears to be the facility they offer for connecting and disconnecting separate machines, more particularly machinery operating upon fabrics. When these have to be started and stopped either gradually or instantly without the slightest shock or jar, these friction clutches prove a most valuable accessory.

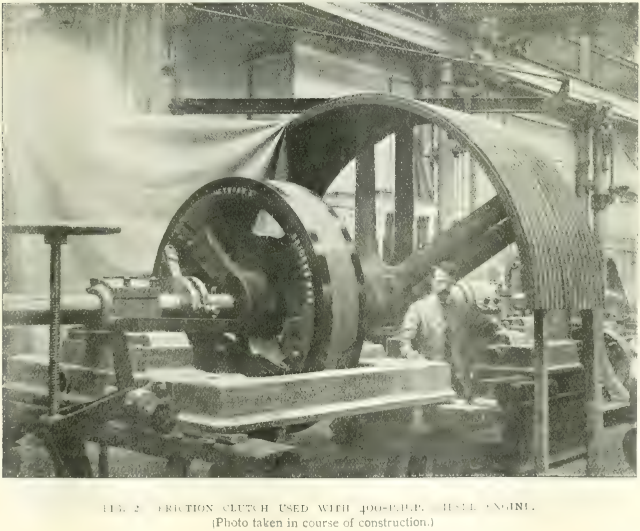


FIG. 2. FRICTION CLUTCH USED WITH 400-B.H.P. DIESEL ENGINE.
(Photo taken in course of construction.)

OUR WEEKLY BIOGRAPHY.

SIR THOMAS RICHARDSON, K.B., D.L., J.P., F.S.S., M.I.M.E., M.I.N.A.,

Vice-Chairman Messrs. Richardsons, Westgarth and Co., Ltd.

SIR THOMAS RICHARDSON, the eldest son of the late Thomas Richardson, M.P., of Kirklevington Hall, Yarm, was born at Castle Eden in 1846. Educated at St. Peter's School, York, and Rossal School, Fleetwood, he afterwards proceeded to Cambridge, where he graduated in Magdalene College. Upon the completion of his university course he became associated in business with his father, who was the head of an engineering firm at Hartlepool.

The public career of Sir Thomas Richardson began with his joining the Middleton Local Board; later on, when that Urban District was taken over by the Borough of Hartlepool, he was elected a member of the Town Council. In 1886 he was made chief magistrate, and the following year he was unanimously re-elected to the mayoral chair. In 1887 he became a member of the Durham County Council.

SIR THOMAS RICHARDSON, K.B., D.L., J.P., F.S.S., M.I.M.E., M.I.N.A.

The engineering business was originally founded at Castle Eden, about sixty-eight years ago, by his grandfather. At that time the construction of locomotives was the firm's chief manufacture. On the death of the founder the locomotive works were carried on by the son, the late Mr. Thomas Richardson, Sir Thomas Richardson's father, and in 1847 the business was transferred to Hartlepool. In 1894 the private limited company of Thomas Richardson and Sons, Ltd., was formed, and in 1900 this concern was amalgamated with Sir Christopher Furness, Westgarth and Co., Ltd., Middlesbrough, and William Allan and Co., Ltd., Sunderland, under the style of Richardsons, Westgarth and Co., Ltd., of which Sir Thomas Richardson is vice-chairman.

It is interesting to recall that in 1883 the firm constructed their first triple-expansion engine for the s.s. *Para*, a cargo boat belonging to Messrs. Steel, Young and Co. The success of this new departure in marine engineering was immediately established, and, as is well known, from that date the triple-expansion engine has met with a wide approval.

With the growth of the shipbuidling industry, the firm's output increased very considerably, but, although so actively engaged in commercial pursuits, Sir Thomas has found time for politics, and in 1895 he was elected M.P. for Hartlepool. He is chairman of the Manchester and Salford Steamship Company, director of the Northern Counties Electric Supply Company, and the County of Durham Electrical Power Distribution Company. He is a member of the Council of the Institution of Mechanical Engineers, member of the Institution of Naval Architects, and a past president of the North-East Coast Institution of Engineers and Shipbuilders. He received the honour of knighthood in 1902.

THE TECHNICAL LIBRARY.

BIBLIOGRAPHY No. 5.—ELECTRICAL WORKS *Continued.*

GENERAL WORKS AND BOOKS FOR STUDENT AND AMATEURS.

Alexander, J. H. Elementary Principles of Electrical Engineering. Crown 8vo. With about 200 illustrations. Price 3s. 6d. net. Crosby Lockwood.

Anderson, Capt. G. L. (U.S. Artillery). Handbook for the Use of Electricians. In the Operation and Care of Electrical Machinery and Apparatus of the U.S. Sea-Coast Defences. Royal 8vo, cloth. 21s. net. Crosby Lockwood.

Ashford, C.E., M.A. Electricity and Magnetism. 304 pages, with over 200 diagrams. Crown 8vo, cloth, 3s. 6d. Edw. Arnold.

Ashworth, J., M.Sc. Magnetism and Electricity. An Introductory Course of Practical, Adapted to the Elementary Stage of the Science and Art Department Examinations. Second edition. Thoroughly revised. 2s. 6d. Whittaker.

Atkinson, P. Elements of Static Electricity. With full description of the Holtz and Töpler Machines, and their Mode of Operating. Second edition. With 64 illustrations. 7s. 6d. Whittaker.

Atkinson, P., A.M., Ph.D. Dynamic Electricity and Magnetism. Crown 8vo, 417 pp., with 120 illustrations, cloth. 10s. 6d. Crosby Lockwood.

Ayrton, Professor. A Laboratory and Lecture Course for First Year Students of Electrical Engineering. With 247 illustrations. Crown 8vo, cloth 7s. 6d. Cassell.

Bate, A. H., A.M.I.E.E. Principles of Electric Power (Continuous Current) for Mechanical Engineers. 63 illustrations. 204 pp., crown 8vo, cloth, 4s. 6d. net. Spon.

Bonney, G. E. Electrical Experiments. A Manual of Instructive Amusement. With 144 illustrations. Second edition. 2s. 6d. Whittaker.

Bottone, S. R. A Guide To Electric Lighting. For Householders and Amateurs. Thirtieth thousand. With many illustrations. Pictorial cover. 1s. Whittaker.

Bottone, S. R. Electrical Instrument-making for Amateurs. A Practical Handbook. With 96 illustrations. Seventh edition, revised and enlarged. 3s. 6d. Whittaker.

Bottone, S. R. Electro-Motors. How Made and How Used. A Handbook for Amateurs and Practical Men. With 90 illustrations. Fourth edition, revised and enlarged. 3s. Whittaker.

Bottone, S. R. Electricity and Magnetism. A Popular Treatise. With 103 illustrations. 2s. 6d. Whittaker.

Bottone, S. R. The Amateur Electrician's Workshop. A Handbook of Practical Instruction in the Making of Electrical Models and Appliances. With 31 illustrations. 1s. 6d. net. Whittaker.

Bottone, S. R. Electrical Engineering. Price 2s. net; post free 2s. 3d. Pitman.

Cook, J., M.A. Magnetism and Electricity. 1s. W. and R. Chambers.

Cumming, L., M.A. Electricity Treated Experimentally. With 242 illustrations. Crown 8vo. 4s. 6d. Longmans.

Cumming, L., M.A. An Introduction to the Theory of Electricity. Illustrated. Fourth edition. Crown 8vo. 8s. 6d. Macmillan.

Curry, C.E., Ph.D. Theory of Electricity and Magnetism. With Preface by Professor L. Boltzmann. Crown 8vo. 8s. 6d. net. Macmillan.

Everett, J. D., M.A., D.C.L. (Ed.) Electricity. An expansion of Part III. of Deschanel's Natural Philosophy on the lines of modern electrical theory. Medium 8vo, cloth, 4s. 6d. Blackie

Ferguson, Dr. Electricity. Revised by James Blyth, M.A. 3s. 6d. W. and R. Chambers.

Fleming, J. A., Magnets and Electric Currents. Second edition. 136 illustrations. 417 pp. crown 8vo, 5s. net. Spon.

Foster, Geo. C. (Ed.) Electricity, Magnetism, and Acoustics. Small 8vo, cloth. 5s. Crosby Lockwood.

Gerard, Prof. Electricity and Magnetism. Translated under the direction of L. Duncan, Ph.D. With additions and 112 illustrations. Medium 8vo, cloth. 12s. 6d. Whittaker.

Gray, Prof. A. Magnetism and Electricity. Vol. I. Medium 8vo. 14s. net. Macmillan

Gunn, R. The Arithmetic of Magnetism and Electricity. 2s. 6d, Blackie.

Hadley, H. E., B.Sc. Practical Exercises in Magnetism and Electricity. Gl. 8vo. 2s 6d Macmillan.

Hadley, H. E., B.Sc. Magnetism and Electricity for Beginners. Gl. 8vo. 2s. 6d. Macmillan.

Harrison, W. J., and White, C. A. Magnetism and Electricity. 2s. Blackie.

Henderson, J., D.Sc. Preliminary Practical Magnetism and Electricity. Crown 8vo. 1s. Longmans.

Henderson, J., D.Sc. Practical Electricity and Magnetism. With 159 illustrations and diagrams. Crown 8vo, 6s. 6d. Longmans.

Henry, J., and Hora K. J. Modern Electricity. A Practical Working Encyclopædia and Manual of Theories, Principles and Applications. 5s. net. Hodder and Stoughton.

Hibbert, W., F.I.C. Magnetism and its Elementary Measurement. With 55 diagrams. Crown 8vo, 2s. Longmans.

Houston, E. J. Electricity One Hundred Years Ago and To-day. With Notes, etc. 5s. Whittaker.

Houston, E. J. and Kennelly, A. E. Magnetism. With 94 illustrations, 5s. Whittaker.

Houston, Electricity and Magnetism. A Series of advanced Primers. Crown 8vo, cloth. 2s. 6d. Whittaker.

Houston. Electrical Transmission of Intelligence, and other Advanced Primers of Electricity. Crown 8vo, cloth. 5s. Whittaker.

Jamieson, Prof. Magnetism and Electricity. Elementary Manual of. For First-Year Students. Sixth Edition. 3s. 6d. Griffin.

(To be continued.)

CONTRACTORS' NEWS.

We shall be pleased to insert under this column, free of charge, particulars of open contracts.

CONTRACTS OPEN.

Last Day

Manchester.—Supply of permanent-way points, tongues, and hardened steel centres, for the Tramways Committee. Mr. J. M. M'Elroy, general manager, Tramways Department, 55, Piccadilly, Manchester ... ... Dec. 23

Salford.—Provision and erection of steelwork, wrought and cast ironwork, brickwork, masonry, etc., required in the reconstruction of two bridges carrying Frederick-road, Pendleton, over the Lancashire and Yorkshire Railway Co.'s line between Manchester and Bolton and the Manchester and Bolton and Bury Canal, for the Building and Bridges Committee of the Salford Corporation. Messrs. C. S. Allott and Sons, 46, Brown-street, Manchester ... ... Dec. 27

Elham (Folkestone). — One or more superheaters for the Elham Union; also a Lancashire boiler. Mr. R. Lonergan, clerk, 11, Cheriton Place, Folkestone ... Dec. 27

Widnes.—Manufacture and erection complete of a four-lift gasholder and external steel guide framing, having a capacity of 900,000 cubic feet, for the Corporation. Mr. Isaac Carr, M.Inst.C.E., Widnes ... Jan. 2

Manchester.—Laying underground telephone pipes (Contract No. 12), with other appurtenant works, for the Special Committee on Telephones. City Surveyor's office, Town Hall, Manchester ... ... Jan. 2

London, E.C.—For the supply and delivery of deck bridges (about 60 ft. in the clear) for the East Indian Railway Company, as per specification to be seen at the Company's offices. Mr. C. W. Young, secretary, Nicholas Lane, London, E.C.... Jan. 3

Grimsby.—For plant, buildings, and cables to the following specifications, for the Corporation: (Specification No. 35) engine and dynamo—500 k.w. continuous-current dynamo direct-coupled to high-speed double-acting engine; (36) water-tube boiler and underfeed stokers; (37) extension of switchboard; (38) condensing plant—surface type; (39) buildings—bills of quantities for extension of engine-room, new coal bunkers, and new store; (43) pipework; (44) coal-conveying plant—two scraper conveyors and one elevator; (45) supply of cables (lead-covered, paper-insulated). Mr. W. A. Vignoles, borough electrical engineer, Corporation Electricity Works, Grimsby... Jan. 5

Last Day

Hamilton (Scotland).—For the removal of the present bridge carrying the Sandford highway over the Kype Water, and the construction of a new steel girder bridge in lieu thereof, for the District Committee of the Middle Ward of the County of Lanark. Mr. W. L. Douglass, district engineer, District Offices, Hamilton ... ... Jan. 5

Leyton, (Essex).—Construction of nine miles of double tramway track, and for all materials connected therewith, for the Leyton Urban District Council. Mr. William Dawson, M.Inst.C.E., surveyor, Town Hall, Leyton ... ... Jan. 8

Southsea.—Extension of pier, for the Southsea Clarence Esplanade Pier Company. Mr. Alfred H. Bone, C.E., engineer, 148, High Street, Portsmouth... Jan. 10

West Hartlepool.—For the works required in connection with the reconstruction of No. 4 graving dock, West Hartlepool, for the North-Eastern Railway Co. Mr. T. M. Newell, engineer, Dock Office, Hull ... ... Jan. 10

COMING CONTRACTS.

Brighton.—Mr. H. R. Hooper has held an inquiry relative to an application of the Corporation for sanction to borrow £38,500 for purposes of electric lighting, and £5,909 for the purchase of a site and the erection of buildings in connection with the electric light undertaking.

Heston and Isleworth.—The proposed borrowing by the Urban District Council of £11,500 for purposes of electric lighting formed the subject matter of an inquiry last week.

St. Austell.—An inquiry respecting an application of the Rural District Council for sanction to borrow £6,380 for purposes of sewerage has been held.

Clydebank.—The Eastern District Committee of the C.C. of Dumbarton are applying for additional catchment area and reservoir accommodation for the Duntocher and Dalmuir water district at an estimated cost of £30,000.

Dunoon (Argyleshire).—The Town Council are considering a proposal to build a refuse destructor and electric power plant at an approximate cost of £10,000.

Shrewsbury.—The Town Council have decided to proceed with the Castle Pulverbatch upland water scheme. The acquisition of the watershed will cost £35,000, and the total cost of the scheme is estimated at £[illegible]8,000.

CONTRACTS CLOSED.

Glasgow.—Messrs. Henry Pooley and Sons, Ltd., have received a contract for five of their heaviest railway wagon weigh-bridges of the self-contained and self-indicating type from the Buenos Ayres Railway Company.

Beckenham.—Beckenham Council has accepted the tenders of Messrs. Babcock and Willcox, Ltd., for boilers at £3,375 and for pipe work at £1,750, of the General Electric Company, for engines and dynamos, the Mirrlees Watson Company for condensers, and Messrs. Elliott Brothers for the switchboard at £545.

Darlington.—The Whessoe Foundry Company, Ltd., of Darlington, have received a contract for the construction of twenty-three huge tanks for the Admiralty. Each tank will have a capacity of 1,640,000 gallons, and when completed will be erected at Gibraltar and stations in the Mediterranean for the storage of oil to be used as fuel by the Navy.

Manchester.—The contract for the electrical installation at the new buildings in Quay Street, Manchester, for H.M. Postal Telegraphs Department has been secured by Messrs. Wright, Methuen and Co., Ltd.

Stoke-on-Trent.—Messrs. Kerr, Stuart and Co., of Stoke-on-Trent, are to supply the steel coal trucks for the London County Council Greenwich Station.

Torquay.—The Town Council have accepted the following tenders for the supply of additional plant for the power house: Siemens Brothers and Co., £5,168 15s., Tudor Accumulator Co., £1,966.

Clacton-on-Sea.—The Urban District Council on December 6th, accepted the following tenders in connection with the plant needed for the power station: Davey, Paxman and Co., horizontal two-cylinder engines with Parker dynamos, £3,676; J. E. Spagnoletti and Co., switchboard, £600; Johnson and Phillips, Ltd., cables, £4,598; D. P. Battery Co., accumulators, £1,450; and J. McKay, Clacton, buildings, £1,848.

London.—The Highways Committee of the London County Council have received the following tenders for the supply of conductor tee-rails for the first section of the northern tramways: Frodingham Iron and Steel Co. (recommended), £8,250; Bolckow, Vaughan and Co., £8,550: P. and W. Maclellan, £8,612; and Steel, Peech and Tozer, £9,050. The tender of C. Wall, Ltd., amounting to £29,006, is recommended for acceptance for the erection of a car shed at Poplar. The Committee also recommend that the tender, amounting to £46,490 7s. 10d., of E. C. and J. Keay, for the supply, delivery and erection of the steelwork for the second portion of the Greenwich electricity generating station, be accepted.

Birmingham.—The tender of Messrs. James Watt and Company, of Birmingham, for supplying a horizontal tandem compound engine, together with deep-well pumps, for the Westerham Hill Waterworks, Kent, has been accepted by the Metropolitan Water Board. Messrs. Thomas Piggot and Co., of Birmingham, have just successfully completed two steel chimneys in South Wales, one 175ft. high and the other 125 ft. high.

Glasgow.—The Mirrlees Watson Company, Ltd., of Glasgow, have sent us a list of important orders for condensing plant which the firm has recently received. These vary in power from 15,000 lb. per hour to 70,000 lb. per hour, and the total capacity of fourteen of the plants is over 360,000 lb. per hour.

London.—The Brush Engineering Company have received the following contracts: Powlesland and Mason, Swansea, locomotive; Great Central Railway, six main line dining coaches, two main line composite coaches, eight main line composite corridor coaches; Mexborough (National Electric Construction Company), sixteen double deck car-bodies.

APPOINTMENTS VACANT.

Pontypridd.—The Urban District Council invite applications for the position of third charge engineer in the electric light and tramways power station. Engineer and manager, Church Street, Pontypridd — Dec. 27

Stockport.—Assistant gas engineer at a commencing salary of £120 per annum, rising, at the discretion of the gas committee, to £200 per annum. Mr. Robert Hyde, town clerk, Stockport ... ... Jan. 3

Bradford.—The Corporation invite applications for the appointment of three engineering assistants in the sewage works, engineer's department, at a salary of £150 each per annum. Mr. Frederick Stevens, town clerk, Town Hall, Bradford... ... Jan. 16

Auckland, New Zealand.—Applications are invited for the appointment of City Engineer to the City of Auckland. High Commissioner for New Zealand, Westminster Chambers, 13, Victoria Street, London, S.W. ... ... Feb. 8

APPOINTMENTS FILLED.

Stourbridge. Mr. Charles H. Webb, assistant engineer and manager of the Stockport Corporation gasworks, has been appointed manager of the Stourbridge Urban District Council undertaking, in succession to Mr. W. North.

Woolwich.—The Borough Council have appointed the assistant electrical engineer (Mr. G. W. Keats) to be acting electrical engineer until the appointment of a successor to Mr. Mitchell. Mr. E. Crosse has been appointed mains assistant engineer to the Woolwich Borough electricity undertaking in place of Mr. C. W. Bloomfield.

Radcliffe.—Mr. Henry Wilkinson, of Radcliffe, has been appointed electrical engineer to the Radcliffe District Council.

Nelson.—The Town Council have appointed Mr. Murray Bolton Henry, engineer and tramways manager, at a salary of £200 per annum

Croydon.—The Borough Council have decided that Mr. Walter Grant, who has been acting as assistant borough engineer since the appointment of the borough engineer, be appointed assistant borough engineer, and that his salary be increased from £200 to £250 per annum as from January 1st next.

Share List of Engineering, Electrical, Iron and Steel, and other Companies.

The following is a comprehensive list of Companies in the industries covered by "Page's Weekly," in which shares business is being currently transacted. Additions will be made from time to time as occasion requires. We desire it to be understood that while our Share List will generally be found correct, we do not hold ourselves responsible for any loss or inconvenience that may arise from possible inaccuracies.

Stock Exchange Settling Days.—Settling days on the Stock Exchange are as follows:—

Consols: Jan. 4th. General Settlements: Dec. 29th; Jan. 11th, 25th. Bank Rate, September 28th, 1905, 4 per cent.

I.—ENGINEERING, IRON, AND STEEL COMPANIES.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
11,370	5	5%	Alldays & Onions Pneumatic Engineering, Ltd.	3	2[illegible] – 3¼
10,000	5	3	Do. Cum. Pref. 6 per cent. ..	5	4⅝ – 4[illegible]
8,210,000	1	1/-	Armstrong (Sir W. G.), Whitworth and Co., Ltd.	1	3 1/16 – 3[illegible]
76,970	5	2/-	Do. 4% Cum. Pref.	5	5[illegible] – 5[illegible]
1,500,000	100	4%	Do. 4% 1st Mort. Dbs. Rd.	100	103 – 105
£100,000	100	4½%	Aveling and Porter, Ltd., 4½% Reg. Mt. Debs. Red.	100	96 – 99
530,000	1	1/7½	Babcock and Wilcox, Ltd., Ord. ..	1	3¾ – 4
100,000	1	7½d.	Do. " 6% Cum. Pref.	1	1 7/16 – 1[illegible]
20,000	5	3/-	Baker (Joseph) and Sons, Ltd., 6% Cum. Pref.	5	5 – 5½
250,000	1	6⅝d.	Baldwins, Ltd., 5½% Cum. Pref. ..	1	1 1/16 – 1[illegible]
£250,000	Stk	4½%	Do. 1st Mt. 4½% Deb. Stk. Red.	100	102 – 104
150,000	4½	[illegible]	Barrow Hæmatite Steel Co., Ld., O.	4½	5 – 5¼
50,000	4½	3	Do. do. Cum 2nd. Pref.	4½	5 – 5¼
33,334	5	2/6	Bayliss, Jones and Bayliss, Ltd., 5% Cum. Pref. Shares	5	4¾ – 5¼
£500,000	100	4½	Beardmore (Wm.) & Co., Ltd. 4½% 1st Mt. Debs., Red., Scrip 50% pd	—	104 – 106
50,000	10	6/-	Bell Brothers, Ltd., 6% Cum. Pref.	10	12¾ – 13¼
£366,600	Stk	4%	Do 4% Deb. Stock, Red.	100	100 – 102
200,000	1	1/-	Beyer, Peacock and Co., Ltd., Ord.	1	[illegible]
300,000	1	6⅜d.	Do. 5½% Cum Pref.	1	[illegible]
£300,000	Stk	4½%	Do. 4½% Red. Deb. Stock	100	93 – 96
1,629,760	1	6d.	Bolckow, Vaughan and Co., Ltd., O. Nos. 1-1,629,760	1	1[illegible] – 1[illegible]
1,860,900	1	3d.	Do. Nos. 1,639,101-3,500,000	12/-	[illegible]
1,160,000	1	4½d.	Brown (John) and Co., Lim., Ord., Nos. 1-1,160,000	15/	1 5/16 – 1[illegible]
590,000	1	6[illegible]	Do. Ord., Nos. 1,160,001-1,750,000	1	1⅞ – 2
74,000	10	5	Do. 5% Cum. Pref.	10	11½ – 12*
154,500	5	2/6	Cammell, Laird & Co., Ltd., Ord. .	5	10¼ – 10¾
232,500	5	2/6	Do. 5% Cum. Pref. ..	5	5½ – 5[illegible]
450,000	1	1/2½	Clayton & Shuttleworth, Ltd., Ord.	1	[illegible] – 1[illegible]
70,000	5	2/6	Do. 5% Cum. Pref	5	5½ – 5[illegible]
£250,000	Stk	4	Do. 4% 1st Mort. Db. Stk. Red	100	100 – 102
100,000	10	30	Consett Iron Co., Ltd., Ord.	7½	35 – 35
57,031	10	10%	Crossley, Bros., Ld., Ord 40340/97370	10	15¾ – 16
40,339	10	[illegible]	Do. 5% Cum. Pref.	10	11½ – 11[illegible]
75,000	1	2/6	Delta Metal, Ltd. Shares	1	2¼ – 2[illegible]
1,259,594	1	3½d.	Dorman, Long & Co., Ltd.	1	[illegible]
£400,000	Stk	4	Do. 4% 1st Mort. Perp. Deb. Stk	100	92 – 95
200,000	5	3	Dunderland Iron Ore Co., Ltd., 6% Cum. Pref. and Participating ..	5	3¾ – 4¼
250,000	1	9d.	[illegible] (James) & Co., Ltd., Ord. ..	1	[illegible]
300,000	1	7½d.	Do. 6% Cum. Pref. ..	1	[illegible]
4,721	13	13	Ebbw Vale Steel, Iron & Coal Co., Ltd.	13	10½ – 11½
69,754	13	10	Do. do. do.	10	9 – 9[illegible]
20,250	10	8	Elliott's Metal, Ltd.	8	5 – 5¼
5,000	10	[illegible]	Do. Cum. Pref. 5%	10	8¾ – 9⅛
186,748	Stk	4	Do. Deb. 4%	100	90 – 94
25,000	10	[illegible]	Fairfield Shipbuilding & Engng. Co., Ltd., 6% Cum. Pref. ..	10	11½ – 12
£250,000	Stk	4	Do. 4½% Mort. Deb. Stk. Red.	100	100 – 103
126,000	3	[illegible]	Fraser & Chalmers, Ltd., Ord. ..	3	3[illegible] – 4[illegible]*
21,000	3	[illegible]	Do. 7½% Cum. Pref.	3	5[illegible] – [illegible]
10,000	10	[illegible]	Galloways, Ltd., 5% Cum. Pref. [illegible] 28000	10	7¼ – [illegible]
£150,000	Stk	4	Do. 4% 1st Mort. Deb. Red. .	100	88½ – 89½
16,800	10	10	[illegible]d & Batley, Ltd., Ord. ..	10	6¾ – 7
9,600	10	7	Do. 7% Cum. Pref.	10	10[illegible] – 11½
965,000	1	1	[illegible] & Nettlefolds, Ltd. Ord.	1	2 1/16 – 2[illegible]
344,000	5	2[illegible]	Do. 5% Cum. Pref.	5	6[illegible] – 6[illegible]
£1,850,500	Stk	4	Do. 4% Irred. Mort. Deb. Stk	100	106 – 108
13,000	[illegible]	[illegible]	[illegible], Ltd., 5% Cum. Pref. .	5	2[illegible] – 2¾
250,000	1	1	[illegible]'s Steel F'dry Co., Ld., Ord.	1	¾ – 1
20,000	10	4[illegible]	Do. 4½% Cum. Pref.	10	10¾ – 11¼
30,000	5	[illegible]	Hall (J. & E.), Ltd. 6% Cum. Pref. ..	5	1[illegible] – [illegible]
408,505	1	1	[illegible] United Steel Co., Ltd. ..	1	[illegible] – 1
47,500	10	7½	[illegible] Leslie & Co., Ltd. Ord.	10	98 – 100
28,001	[illegible]	[illegible]	[illegible]btson & Co., Ltd. ..	5	5½ – [illegible]
85,000	1	7	Hill (Richard) & Co. (1899) Ld., Ord.	1	[illegible]
18,000	[illegible]	[illegible]	Do. [illegible] Cum. Pref.	5	5 – 5[illegible]
£100,000	Stk	[illegible]	[illegible] (Richard) & Sons, Ld., Ord. [illegible] Cum. Pref.	100	101 – 10[illegible]

ENGINEERING, IRON, AND STEEL COMPANIES.—*Contd.*

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
750,000	1	7½%	Howard & Bullough, Ltd., Ord. ..	1	1[illegible] – 1 11/16
25,000	10	6/-	Do. 6% Pref. (Non-Cum.) ..	10	12½ – 13
£250,000	Stk	4%	Do. 4% Deb. Stk., Red. after 1905	100	98 – 101
37,500	10	20	Kynoch, Ltd.	10	18¼ – 18¾
49,537	10	5%	Do. Cum. Pref. 5% .. .	10	10⅝ – 10⅞
300,000	1	4⅞d	Lambert Bros., Ltd., Ord.	1	[illegible] – ⅞
50,000	5	2/9	Do. 5½% Cum. Pref .. .	5	4¼ – 4¾
40,000	3	2/1½	Leeds Forge Co., 7% Cum. Pref. ..	3	4 – 4¼
200,000	1	7¼d	Lysaght (John), Ltd., 6% Cum. Pf.	1	1 5/16 – 1 7/16
£300,000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk., Red.	100	110 – 112
40,000	10	5/-	Mather & Platt, Ld., 5% Cum. Pref	10	11¼ – 11¾
210,000	1	8⅝d.	Measures Bros., Ltd., Ord.	1	[illegible] – 1 1/16
75,000	1	6⅝d.	Do. 5½% Cum. Pref.	1	[illegible] – 1 1/16
£75,000	Stk	4½%	Do. 4½% 1st Mt. Db. Stk., Red.	100	98 – 101
21,943	5	2/6	Muntz Metal, Ltd.	5	4[illegible] – 5¼
14,248	5	5%	Do. Pref. 5%	5	4[illegible] – 5¼
5,000	62½	47/6	Nantyglo and Blaina Iron Works, Ltd., 8% Cum. Pref.	62½	78 – 81
73,000	10	5/-	N. Brit. Loco. Co., Ltd., 5% Cm. Pf.	10	12[illegible] – 12[illegible]
80,000	5	—	North-Eastern Steel Co., Ltd.,		
£250,000	Stk	4½%	4½% 1st Mt. Db. Stk., Red.	100	[illegible] – 93
122,000	5	1/6	Pearson & Knowles Coal and Iron Co., Ltd., Ord., "B"	5	5 – 5¼
50,000	5	3/-	Do. 6% Cum. Pref. "A" .	5	6 – 6½
70,000	10	10/-	Pease & Partners, Ltd., Ord. ..	10	13 – 13½
£400,000	Stk	4%	Do. 4% Perp. Deb. Stock .	100	[illegible] – 102
20,000	5	3/-	Peebles (Bruce) & Co., Ld., 6% Cm. P	5	4⅝ – 5⅛
65,000	1	—	Pooley (Henry) & Son, Ltd., Ord ..	1	10/6 – 10/9
13,000	5	—	Do. 5½% Cum. Pref.	5	4[illegible] – 4[illegible]
230,000	1	—	Projectile Co. (1902), Ltd., Ord. .	1	[illegible]
126,938	5	2/-	Rhymney Iron Co., Ltd.	5	2[illegible] – 2[illegible]
73,062	5	2/-	Do. New	5	1[illegible] – [illegible]
£330,000	—	5%	Do. 5% Mort. Deb., Red. ..	100	102 – 104
350,000	1	1/2½	Richardsons, Westgarth & Co., Ltd., Ord. 350,001 700,000 ..	1	[illegible] – 1
£350,000	1	7½	Do. 6% Cum. Pref.	1	[illegible] – 1 1/16
£350,000	Stk	4½%	Do. 4½% Perp. Deb. Stock ..	100	98 – 101
35,000	10	12/-	Ruston, Proctor & Co., Ltd.	10	10½ – 11
275,000	1	6d.	Scott (Walter) Ltd., Ord. ..	1	[illegible]
300,000	1	7½d.	Do. 6% Cum. Pref. .	1	1 – 1 1/16
£300,000	Stk	4%	Do. 4% Perp. Deb. Stk.	100	94 – 97
£115,300	100	5%	Shelton Iron, Steel and Coal Co., Ld. 1st Charge 5% Debs. Red ..	100	[illegible] – 97
£97,900	100	6%	Do. 6% 2nd Mort. Debs., Red.	100	98 – 102
250,000	1	1/-	South Durham Steel & Iron, Ltd. Or.	1	1[illegible] – 1¼*
300,000	1	1/2½	Do. 6% Cum. Pref. ..	1	1[illegible] – 1 1/16
£300,000	Stk	4½%	Do. 4½% Per. Deb. Stock	100	93 – 96
25,000	10		Stephenson (Robert) & Co., Ltd., Or.	10	2 – [illegible]
25,000	10	5/6	Do. 5½% Cum. Pref. ..	10	[illegible] – 5½
£250,000	Stk	4%	Do. 4% Perp. Deb. Stock	100	80 – 83
80,000	10	9/-	Stewarts & Lloyds, Ltd., Ord ..	10	19 – 19½
55,000	10	6/-	Do. 6% Cum. Pref	10	14½ – 15
694,732	1	6d.	Swan, Hunter & Wigham Richardson, Lim. Ord.	1	[illegible]
538,845	1	6d.	Do. 5% Cum. Pref ..	1	[illegible] – 1 1/16
£240,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Red	100	[illegible] – 99
[illegible]00,000	1	6d.	Thames Iron Works, Shipbuilding & Engineering Co., Ltd., 5% Cum. Pf.	1	[illegible]
£200,000	100	4%	Do. 4% Irredeem. 1st Mort. Deb.	100	80 – 84
£[illegible]	1	7½d.	Thornycroft (John I.) & Co., Ltd. Or.	1	[illegible]
£160,000	1	7½d.	Do. do. 6% Cum. Pref.	1	[illegible] – 1 1/16
[illegible]	10	5/-	Tylor (J.) & Sons, Ltd. 5% Cum. Pf.	10	9¼ – 9¾
$[illegible]	$100	$½	United States Steel Corp. Com. Stk	$100	38¼ – [illegible]
$[illegible]	$100	$1¾	Do. 7% Cum. Pref. Stock	$100	106 – 107¼
$[illegible]	$1000	5%	Do. 10-60 yr. 5% Skg. Fd. G. Bds.	$1000	99 – 101
3,350,000	1	1/-	Vickers, Sons & Maxim Ltd. Ord. ..	1	2[illegible] – 2[illegible]
750,000	1	6d.	Do. 5% Non-Cum. Pref. ..	1	1[illegible] – 1[illegible]
£750,000	Stk	5%	Do. 5% Non-Cum. Pref. Stock.	100	121 – 124
£1,250,000	Stk	4%	Do. 4% 1st. Mort. Deb. Stk. Red.	100	103 – 105
£1,000,000	100	4½%	Do. 4½% 2nd Mort. Debs., Red.	100	104 – 105
[illegible]	1	1/2½	Weardale Steel, Coal & Coke, Ltd., Def. Ord.	1	1 – 1
[illegible]	1	7½d	Do. 6% Cum. Pref. Ord. ..	1	1⅛ – 1[illegible]
£300,000	Stk	4%	Do. 4% Perpetual Deb. Stock	100	9[illegible] – 95
[illegible]	5	3/.	Willans & Robinson, Ord. ..	5	1¼ – 2¼
66,666	[illegible]	3/-	Do. 6% Cum. Pref.	5	3 – [illegible]
[illegible]	Stk	4	Do. 4% 1st Mort. Deb. Stk. Red	100	8[illegible] – 87
£150,000	Stk	4½%	Yorkshire Iron & Coal Co., Ltd., 4½% 1st Mort. Deb. Stk. Red.	10	77 – 79

Stocks and Shares marked * [illegible] dividend.

II.—ELECTRICAL MANUFACTURING COMPANIES.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
70,000	1	6d.	Alliance Elec. Co., Ltd. 5% Cum. Pf.	1	[illegible]
125,000	1	7½d.	Aron Elec. Meter Ltd., 6% Cum. Pf.	1	½ – [illegible]
120,000	1	1,2½	Bell's Asbestos Co., Ltd.	1	1½ – 1⅝
£40,000	[illegible]	9d	British Aluminium Co. 7% Cum Pref.	[illegible]	5 – [illegible]
£500,000	Stk	5%	Do. 5% 1st Mort. Deb. Stk. Rd.	100	98 – 102
100,000	5	4/-	British Insulated & Helsby Cables Ltd., Ord. ..	5	[illegible] – 7
100,000	[illegible]	3/-	Do. 6% Cum. Pref.	5	5¾ – 6¼
£500,000	Stk	4½%	Do. 4½ 1st Mort. Deb. Stk. Rd.	100	103 – 106
£200,000	Stk	4½%	British Thomson Houston Co., Ltd., 4½ 1st Mort. Deb. Stk. Red. ..	100	98 – 100
400,000	[illegible]	8/-	British Westinghouse Electric and Manufac. Co., Ltd., 8% Pref. ..	5	1¾ – 2¼
£616,353	Stk	4%	Do. 4% Mort. Deb. Stk. Red. ..	100	80 – 85
105,731	2	2/-	Brush Elec. Enging. Co., Ltd., Ord. .	2	¼ – ½
160,000	2	2 4½	Do. 6% Pref.	2	1¼ – 1¾
£125,000	Stk	4½%	Do. 4½ Perp 1st Deb. Stk. ..	100	96 – 100
£125,000	Stk	4½%	Do. 4½ Perp. 2nd Deb. Stk.	100	84 – 86
[illegible],000	5	[illegible]	Callender's Cable & Constn. Ltd. Ord.	5	11 – 12
40,000	[illegible]	2 6	Do. 5% Cum. Pref.	5	5⅝ – [illegible]
£200,000	Stk	4½	Do. 4½ 1st Mort. Deb. Stk. Red.	100	109 – 111
85,000	[illegible]	1/6	Crompton & Co., Ltd.	3	2 – 2¼
£100,000	[illegible]	5%	Do. 5% 1st Mort. Reg. Debs.	100	97 – 100%
52,000	5	10/-	Dick, Kerr & Co., Ltd., Ord. ..	5	8¼ – [illegible]
61,000	5	3/-	Do. 6% Cum. Pref.	5	5¾ – [illegible]
£300,000	Stk	4½%	Do. 4½ Deb. Stock, Red. .	100	106 – 108
233,334	1	6d.	Doulton & Co., Ltd., [illegible] Cum. Pref.	1	1⅛ – 1¼
£233,334	Stk	4%	Do. 1st Mort. 4% Free. Deb. Stk.	100	107 – 110
99,261	5	1 6	Edison and Swan United Electric Light, Ltd., "A" Shares Nos. 1-99,261	3	1⅝ – 1⅞
17,139	[illegible]	2/6	Do. "A" Shares Nos. 01-017,139	5	2¼ – 2¾
£344,023	Stk	4%	Do. 4% Deb. Stock Red. .	100	85 – 90
£100,000	Stk	5%	Do. 5% Second Deb. Stk. Red.	100	94 – 97
112,100	2	1 7½	Electric Construction Co. Ltd. .	2	[illegible]
31,390	2	2 9¾	Do. 7% Cumulative Pref. ..	2	1⅝ – 2⅛
£200,000	Stk	4%	Do. 4% Perp. 1st Mt. Deb. Stk.	100	92 – 95
10,248	10	7/6	Evered and Co., Ltd. . .	10	9 – 11
25,000	10	5/-	Gen. Elect. Co. (1900), Ltd., 5% Cum. Pref.	10	9¼ – 9¾
£[illegible]00,000	Stk	4%	Do. 4% 1st. Mt. Deb. Stk., Red.	100	96 – 100
[illegible],000	5	5/-	Henley's (W. T.) Telegraph Works Co., Ltd., Ord.	5	12½ – 13½
35,000	5	2/3	Do. 4½% Cum. Pref. ..	5	5½ – [illegible]
£50,000	Stk	4½%	Do. 4½% Mt. Deb. Stk. Red.	100	[illegible]
[illegible]0,000	10	5/-	India Rubber, Gutta Percha & Telegraph Works Co., Ltd.,	10	18½ – 19½
£300,000	100	4%	Do. 1st Mort. Deb. Red. ..	100	99 – 102
7,500	10	—	Parker, Thos. Ltd.	10	6¼ – 7
100,000	1	3%	Scott (Ernest) & Mountain, Ld., Ord.	1	17/3 – 17/9
[illegible]	12	12/	Telegraph Construction and Maintenance Co., Ltd.	12	32 – 34
[illegible],000	100	4%	Do. 4% Deb. Bonds	100	102 – 104

III.—ELECTRIC TRACTION.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
120,[illegible]	5	3/-	Anglo Argentine Trams Co., Ld., Or.	5	[illegible]
260,[illegible]7	5	2/6	Do. 5% Cum Pf.	5	5½ – 6½
£[illegible],000	Stk	6%	Do. Permanent 6% Debenture Stock, 1888 ..	100	142 – 145
29,000	[illegible]	12/-	Barcelona Trams Co., Ltd., Ord. ..	10	13¾ – 14¼
10,000	[illegible]	5/-	Do. 5% Cum Pf. Shares	10	9½ – 10
£46,300	100	5%	Do. 5% Debs., Red. ..	100	98 – 101
£[illegible]	Stk	4½%	Do. 4½ Red. Deb. Stk.	100	97 – 102
[illegible]	1	—	Bath Elec. Trams. Ld., Pf. Or. ..	1	[illegible] – 1
[illegible]	1	11·1d	Do. 5% Cum. Pf. ..	1	[illegible] – 1⅛
7[illegible]	[illegible]	-	Brisbane Electric Tram Investment Co., Ltd., Ord.	5	1 – 1½
7[illegible],000	[illegible]	2/6	Do. 5% Cum Pf. .	5	4 – 4¼
£[illegible]	Stk	4½%	Do. 4½ 1st Deb. Stk., Red.	100	95 – 98
£[illegible]	Stk	6%	Brit. Columbia Elec. Rly. Co., Ltd., Def. Ord. Stock	100	119 – 122
		5%	Pref. Ord. Stock	100	109 – 113
133,[illegible]	10	6/-	Int. Electric Traction, Ltd., Ord.	10	7½ – 8½
156,4[illegible]7	10	6/-	Do. 6% Cum. Pref.	10	10 – 11
£1,000,000	Stk	5%	Do. 5% Perp. Deb. Stk. .	100	117 – 119
£250,000	Stk	4½%	Do. 4% 2nd Deb. Stk. Red. .	100	97 – 99
100,000	[illegible]	2/6	Buenos Ayres & Belgrano Electric Trams, Ltd., Ord.	5	3[illegible] – 3[illegible]
40,500	5	[illegible]	Do. "A" [illegible] Cum Pref. ..	5	[illegible]
[illegible]7,000	5	[illegible]	Do. "B" do.	5	[illegible]
£200,000	Stk	5%	Buenos Ayres Elec. Trams Co. (1901) Ltd., 5% Db. Stk., Red.	100	98 – 100
£220,000	100	6%	Buenos Ayres Gd. Nat., Ltd., 6% 1st Deb. Bds.	100	101 – 1[illegible]

Stocks and Shares [illegible] are [illegible]

ELECTRIC TRACTION.—Contd.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up.	Closing Prices
102,268	[illegible]	5/-	Calcutta Tramways Co., Ltd. .	[illegible]	[illegible]
£350,000	Stk	4½%	Do. 4½% 1st Deb. Stk., Red	100	[illegible]
480,000	1	6d.	Cape Electric Tramways, Ltd. ..	1	[illegible]
40,000	5	2/6	City of Birmingham Tram. Co., Ltd 5% Cum. Pref	5	[illegible]
£300,000	100	4%	Do. 4% 1st Mort. Debs. .	100	100 – 103
£120,000	Stk	[illegible]	Colombo Elec. Tram. & Light. Co., Ltd., 5% 1st Mort. Deb. Stk. Red.	100	101 – 103
60,000	10	6/	Dublin United Trams. Co. (1896), Ltd., Ord. ..	10	13[illegible] – 14[illegible]
59,987	10	6/-	Do. 6% Pref. . .	10	[illegible]
£125,000	Stk	4½	Hastings & Dist. Elec. Trams. Co., Ltd., 4% Deb. Stock. Red	100	[illegible]
30,000	5	2/6	Isle of Thanet Elec. Trams. and Light. Co., Ltd., 5% Cum. Pref.	5	2½ – [illegible]
£150,000	Stk	4%	Do. 4% Deb. Stock .. .	100	83 – [illegible]
125,000	10	5/	London United Trams. (1901), Ltd., 5% Cum. Pref. .. .	10	10 – 10[illegible]
£1,031,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	100 – 103
60,007	1	1,	London Motor Omnibus Co., Ltd., Ord. No. 1—60,007 . ..	1	[illegible]
£50,000	Stk	5	Madras Electric Trams (1904) Ltd., 5% Deb. Stock, Red. . .	100	103 – 10[illegible]
314,016	1	—	Metropolitan Elec. Trams, Ltd., Def	1	
500,000	1	6d.	Do. 5% Cum. Pref. . .	1	1 – 1[illegible]
£350,000	Stk	4½%	Do. 4½% Deb. Stock, Red.	100	10[illegible] – 1[illegible]
50,000	5	6/-	New General Traction Co., Ltd., 6% Cum. Pref.	5	[illegible]
110,923	8	2/9	North Metropolitan Tramways Co. .	8	4 – 4[illegible]
£150,000	100	3½%	Do. 3½% Mort. Debs.	100	93 – [illegible]
£196,200	Stk	5%	Perth Electric Trams, Ltd. (W.A.) 5% 1st Mort. Deb. Stock, Red. .	100	104 – 107
24,500	10	10/-	Potteries Elec. Traction Co., Ld., Or.	10	[illegible]
24,500	10	5/-	Do. 5% Cum. Pref. ..	10	9[illegible] – 10[illegible]
£220,000	Stk	4½%	Do. 4½ Deb. Stk., Red.	100	102 – 10[illegible]
£160,000	Stk		Sunderland Dist. Elec. Trams. Ltd., 5% 1st Mort. Deb. Red.	100	[illegible]
£275,000	Stk	12/11	Yorkshire (W. Riding) Elec. Trams Co., Ltd., 4½% 1st Deb. Stk., Red.	100	9[illegible]

IV.—ELECTRIC LIGHTING AND POWER.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
7,500	10	11/-	Bournemouth & Poole Elec. Sup. Co., Ltd., Ord. ..	10	[illegible]
7,500	10	4/6	Do. 4½ Cum. Pref. .	10	1[illegible] – 1[illegible]
7,500	10	6/-	Do. 6% Cum Second Pf. ..	10	11[illegible] – 1[illegible]
£70,000	Stk	4½%	Do. 4½% Deb. Stock Red ..	100	107 – 10[illegible]
14,000	5	3/6	Bromley (Kent) Elec Lt. & Pr. Co. Ld	5	[illegible]
£50,000	Stk	4½%	Do. do. 4½% 1st Deb. Stk. Red.	100	10[illegible]
27,507	[illegible]	4 6	Brompton & Kensington Elec. Supply Co., Ltd. Ord. .	5	[illegible]
12,493	[illegible]	3/3	Do. 7% Cum. Pref. Shares. .	5	[illegible]
60,000	5	3/[illegible]	Calcutta Elec. Sup. Cor. Ltd., Ord. .	5	[illegible]
£288,782	Stk		Central Elec. Sup. Co., Ltd., 4% Gua Deb. Stk. ..	100	[illegible]
70,000	5	2/6	Charing Cross & Strand Elec. Sup. Corp., Ltd., Ord .. .	5	[illegible]
80,000	5	2/3	Do. do. 4½% Cum. Pref.	5	[illegible]
£350,000	Stk	4%	Do. do. 4% Deb. Stk. Red.	100	101 – 1[illegible]
41,436	5	2 3	Chelsea Elec. Sply. Co., Ltd., Ord.	5	[illegible]
£150,000	Stk	4½%	Do. do. 4½% Deb. Stk., Red	100	110 – 112
70,595	10	7	City of London El. Lghtg. Co., Ld., O.	10	11 – [illegible]
40,000	10	6/	Do. 6% Cum. Pref.	10	15[illegible] – [illegible]
£400,000	Stk	[illegible]	Do. 5% Deb. Stk., Red ..	100	1[illegible] – 1[illegible]
£300,000	Stk	4½	Do. 4½ 2nd Deb. Stk., Red	100	10[illegible]
40,000	10	[illegible]	County of London Elec. Supply Co., Ltd., Ord.	10	[illegible]
30,000	10	6	Do. 6% Cum. Pref.	10	[illegible]
£400,000	Stk	4½	Do. 4½% Deb. Stk., Red. ..	100	112 – 115
70,000	[illegible]	[illegible]	Edmundson's Elec. Cor. Ltd., Ord	5	
70,000	[illegible]	3	Do. 6% Cum. Pref. .. .	5	
£300,000	Stk	[illegible]	Do. 4½% 1st Mort Db. Stk. Reg	100	10[illegible] – 1[illegible]
£[illegible]0,000	Stk	[illegible]	Electric Lighting & Traction Co. of Australia, Ltd 5% Deb. Stk. Red.	100	8[illegible]
19,000	[illegible]		Folkestone Elec. Supply Co., Ld., O	5	5½
£50,000	Stk	4½	Do. 4½% 1st Deb. Stk., Red.	100	10[illegible]
15,000	10		Havana Electricity Co., Ltd .. .	10	[illegible]
13,000		[illegible]	Hove Elec. Lighting Co., Ltd., Ord.	5	[illegible]
£50,000	Stk	[illegible]	Isle of Wight Electric Light & Power Co., Ltd. 4½ Deb. Stock, Red.	100	[illegible]
150,000	1		Kalgoorlie Electric Power & Lighting Corp, Ltd., 6% Cum. Pref.	1	
21,000	[illegible]	[illegible]	Kensington and Knightsbridge Electric Lighting Co., Ltd., Ord. ..	[illegible]	

ELECTRIC LIGHTING AND POWER.—*Contd.*

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
£135,000	Stk	4%	Kensington and Knightsbridge Electric Lighting Co., Ltd., and the Notting Hill Electric Lighting Co., Ltd., 4% Deb. Stock, Red.	100	98 —101
111,000	3	1·9⅜	London Elec. Supply Corp., Ld., Ord.	3	1¾ - 2¼
60,000	5	3/-	Do. 6% Pref.	5	4¾— 5¼
£371,895	Stk	4%	Do. 4% 1st Mort. Db. Stk., Red.	100	97 —100*
100,000	10	5/-	Metropolitan Elec. Sup. Co., Ld., Or.	10	9 —10
76,121	5	2/3	Do. 4½% Cum. Pref.	5	5¼— 5¾
220,000	Stk	4½%	Do. 4½% 1st Mort. Db. Sk., Red.	100	109 —113
250,000	Stk	3½%	Do. 3½% Mort. Deb. Stk., Red.	100	97— 99
£250 000	—	4½%	Midland Elec. Corp. for Power Distribution, Ld., 4½% 1st Mort. Deb.	100	101—103
10,852	10	8/-	Notting Hill Elec. Ltg. Co. Ltd. Ord.	10	13¼ 14¼
£59,000	100	4%	Do. 4% 1st Mort. Debs. ..	100	98 -100
16,500	5	2/6	Oxford Electric Co. Ltd., Ord. ..	5	6¼ - 6¾
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	100 —102
£84,700	100	4½%	Royal Elec. Co. (of Montreal) 4½% 20-yr. 1st Mort. Deb	100	100 —103
40,000	5	5/-	St. James' & Pall Mall Elec. Light Co., Ltd. Ord.	5	12¾ —13¾
20,000	5	3/6	Do. 7% Pref...	5	[illegible]
£150,000	Stk	3½%	Do. 3½% Deben. Stock, Red	100	98 —100
12,000	5	4/-	Smithfield Markets Elec. Supply Co., Ltd. Ord.	5	2 — 2½
£50,000	Stk	4%	Do. 4% Debenture Stk. Red.	100	76 — 80
65,000	5	4/-	South London Elec. Sup. Co., Ltd. O.	5	3 — 3½
100,000	1	—	South Metropolitan Elec. Light & Power Co., Ltd. Ord.	1	[illegible]
50,000	1	8⅖d.	Do. 7% Cum. Pref.	1	1⅛ —1⅜
£100,000	Stk	4½%	Do. 4½% 1st Deb. Stock Red.	100	105 —108
50,000	5	2/6	Urban Electric Supply Co., Ltd., O.	5	4½ — 4¾
30,000	5	2/6	Do. 5% Cum Pref.	5	5 — 5½
£200,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk. Red	100	104 —106
110,000	5	6/6	Westminster Elec. Supply Corp. Ltd., Ord.	5	11½—12½
28,151	5	2/6	Do. 5% Cum. Pref.	5	5½— 6½

V.—TELEGRAPH & TELEPHONE COMPANIES.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up.	Closing Prices
£34,800	100	4	African Direct Tel. Co., Ld., 4% Mt. Debs. (Series A), Red.	100	99 102
25,000	10	—	Amazon Telegraph Co., Ld... ..	10	3¾ - 4¼
£763,580	Stk	14/-	Anglo American Tel. Co., Ltd., Ord.	100	61 63
£3,118,210	Stk	28/-	Do. 6% Preferred Ordinary	100	109 110
£3,118,210	Stk	2/-	Do. Deferred Ordinary ..	100	16⅞ — 17⅛
44,000	5	5/	Chili Telephone Co., Ltd.	5	7¾ — 8
$15,000,000	$100	$2	Commercial Cable Co., Capital Stk.	$100	—
£1,903,876	Stk	4%	Do. Sterl. 500-yr 4% Deb. Stk., Red.	100	96½ 98½
16,000	10	5/-	Cuba Submarine Tel. Co., Ld., Ord.	10	8¾ 9
6,000	10	10/-	Do. 10% Preference .. .	10	17 —18
6,000	5	2/	Direct Spanish Telegraph Co., Ord.	5	3⅜ 3⅝
		5/	10% Cum. Preference	5	8¼ 9
£30,000	50	4½%	Do. 4½% Debs.	50	100-104
60,710	20	[illegible]	Direct U.S. Cable Co., Ltd. . ..	20	14 15
£85,800	100	4½%	Direct West India Cable Co., Ltd., 4½% Reg. Debs.	100	101 103
£300,000	100	4	East. & S. African, Ld., 4% Mt. Dbs.	100	100—102
£200 000	25	4	Do. 4% Rg. Mt. Dbs. (Mauritius Subsidy)..	25	100—102
300 000	10	2/6	Eastern Extension, Australasia and China, Ltd...	10	14½ - 15
£602,400	Stk	4	Do. 4% Mort. Deb. Stk., Perp.	100	106 108
£4,000,000	Stk	25	Eastern Tele. Co., Ltd., Ord. .	100	144 147
£2,000,000	Stk	7	Do. [illegible] Pref. .. .	100	90 92
£1,[illegible]	Stk	4	Do. 4% Mort. Deb.	100	106 108
150,000	10	[illegible]	Great Northern Telegraph Co., Ltd., (of Copenhagen) ..	10	37 38
£58,700	100	4	Halifax and Bermudas Cable Co., Ltd., 4½% 1st. Mort. Debs. Red.	100	101 10[illegible]
[illegible],000	25	[illegible]	Indo-European Tele. Co., Ltd. ..	25	57 59
72,680	1	[illegible]	Monte Video Telephone Co., Ltd., O.	1	[illegible] 1
£1,983,[illegible]	Stk	[illegible]	National Telephone Co., Ltd., Pref.	100	110 111½
£1,[illegible]667	Stk	[illegible]	Do. Deferred	100	108 110
[illegible]0,000	5	[illegible]	Do. 5% Non-Cum. 3rd Pref.	5	5⅜ [illegible]
£2,000,000	Stk	3½	Do. 3½% Deb. Stk., Red. ..	100	[illegible] 1[illegible]
£[illegible]	Stk	4	Do. 4% do. do.	100	104 106
179,[illegible]	1	[illegible]	Oriental Telephone & Elec. Co., Ltd.	1	1¼ 1[illegible]
50,000	1	7[illegible]	Do. [illegible] Cum. Pref. ..	1	1¼ 1[illegible]
£160,000	100	4	Pacific & European Tel. 4% Guar. Debs. Red...	100	100—103
11,[illegible]	8	[illegible]	Reuter's Telegram Co., Ltd. ..	8	7 [illegible]
58,000	5	[illegible]	United River Plate Telep. Co., Ltd.	5	7½ [illegible]
10,000	5	2/[illegible]	Do. [illegible] Cum. Pref. .. .	5	[illegible]
£179,947	Stk	[illegible]	Do. 5% Deb. Stock, Red. ..	100	111 11[illegible]
15,[illegible]	10	[illegible]	W. African Telegraph Co., Ltd. ..	10	9½ 10
£20,000	2½	[illegible]	[illegible] Coast of America, Ltd. .	2½	[illegible]
[illegible]0,000	100	[illegible]	[illegible], Guar. by West. Tel	100	100 10[illegible]

TELEGRAPHS AND TELEPHONES.—*Contd.*

Present Amount Subscribed.	Shares	Last Dividend	Name	Paid up	Closing Prices
88,321	10	6d.	W. India & Panama Teleg. Co., Ld., Or.	10	½— ¾
34,563	10	6/-	Do. 6% Cum. 1st. Pref. ..	10	8¼— 8¾
4,669	10	6/-	Do. 6% Cum. 2nd Pref. ..	10	6½ 7½
£80,000	100	5%	Do. 5% Deb.	100	101 —104
207,930	10	3/-	Western Telegraph Co., Ltd. ..	10	13¾ —14¼*
£75,000	100	5%	Do. 5% Debs., 2nd Series, 1906	100	102 —104
518,945	Stk	4%	Do. 4% Deb. Stock, Red. ..	100	103½—105½

VI.—SHIPPING COMPANIES.

Present Amount Subscribed.	Shares	Last Dividend	Name.	Paid up	Closing Prices
32,500	10	5/6	Anchor Line (Henderson Bros.), Ltd., 5½% Cum. Pref.	10	9¼— 9¾
£325,000	Stk	4½%	Do. 4½% Red. 1st Mort. Deb. Stk.	100	100—102
£672,900	Stk	4½%	British & African Stm. Nav. (1900) Ltd., 4½% 1st Mort. Deb. Stk. Red.	100	99 —101
10,000	10	5/6	Bucknall Steamship Lines, Ltd., 5½% Cum. Pref.	10	6½ - 6¾
£600,000	Stk	4½%	Do. 4½% 1st Mort. Deb. Stk.	100	
£750,000	Stk	4½%	Clan Line Steamers, Ltd., 4½% Deb. Stk. Red. ..	100	99 —101
60,000	20	16/-	Cunard Steam Ship Co., Ltd., Nos. 1-60,000..	20	13 - 13½
40,000	20	8/-	Do. Nos. 60,001-100,000	10	5¾— 6¼
£464,430	Stk	4½%	Elder Dempster Shipping, Ltd., 4½% 1st Mort. Deb. Stk. ..	100	102—104
1,200,000	1	6d.	Furness, Withy & Co., Ltd., Ord...	1	1¼ — 1½
25,328	7½	4/7	Gen. Steam Navigation Co., Ld., Ord.	7½	5 — 5½
36,758	8	4/9⅗	Do. Non-Cum. 6% Pref.	8	8¾— 9¼
£150,000	Stk	4%	Do. 4% 1st Mort. Deb. Stk. Red.	100	98 —100
55,000	5	1/3	Houlder Line, Ltd., Ord.	5	1 — 2
40,000	5	2/9	Do. 5½% Cum. Pref.	5	2¾— 3¼
£200,000	Stk	4½%	Do. 4½% 1st Mt. Deb. Stk. Red.	100	87 — 90
141,500	10	5/-	Leyland (Fredk.), & Co.. (1900), Ltd., 5% Cum. Pref. ..	10	5½— 6
20,349	10	5/-	Orient Stm. Nav. Co.. Ltd., Pref Nos. 1-20,349 ..	10	7 7½
£103,100	Stk	4%	Do. 4% Deb. Stk., Red. ..	100	89—92
£1,160,000	Stk	5 %	Peninsular and Oriental Steam Nav. Co., 5% Cum. Pref. ..	100	125 —128*
£1,160,000	Stk	19%	Do. do Deferred ..	100	238—241*
15,000	100	30/-	Royal Mail Steam Packet Co. Ord..	60	46 — 47
39,075	5	2/6	Shaw, Savill & Albion, Ltd., 5% Cum. "A" Pref..	5	4¾ - 5¼
39,075	5	2/6	Do "B" Ord...	5	3¾— 4¼
141,841	10	4/-	Union Castle Mail Steamship Co., Ltd., Ord..	10	8¾— 9
24,000	10	4/6	Do. 4½% Cum. Pref... ..	10	10¾ — 11¼
£1,008,894	Stk	4%	Do. 4% Debenture Stk., Red.	100	101 —103

VII.—MISCELLANEOUS COMPANIES.

Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
[illegible]0 000	1	9⅗d.	Chadburn's (Ship) Tele. Ltd., Ord...	1	[illegible] —1½
£750,000	Stk	5%	General Hydraulic Power Co., Ltd.	100	12[illegible] —128
12,500	10	10/	Oakey (John) and Sons, Ltd., Ord..	10	26 — 28
10,000	10	6/-	Do. do. 6% Cum. Pf	10	14 — 15
183,538	1	6·3d.	Power Gas Corp., Ltd., Ord., Nos. 66,463 250	15/	[illegible]
66,462	1	8·4d.	Do. do. Nos. 1 66,462	1	[illegible]
13[illegible],000	1	6d.	Waygood (R.) & Co., Ltd., Ord. ..	1	1 -1[illegible]
[illegible],000	1	7⅛d.	Do. 6% Cum. Pref. ...	1	1[illegible] -1[illegible]

RAILWAY CARRIAGE & WAGON COMPANIES.

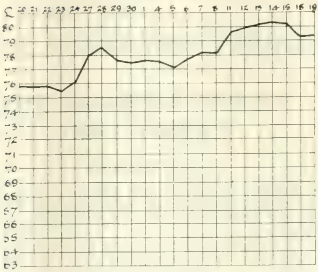
Present Amount Subscribed	Shares	Last Dividend	Name	Paid up	Closing Prices
10,000	10	7/6	Birm. Railway Car. & Wagon, L., 1-10,000	10	[illegible]
8,739	10	3/-	Do. Second Issue 1-8,739 ...	4	[illegible] 10
10,000	10	6	Do. Cum. Pref. 6% 1-10,000..	10	13 14½
30,111	7	7/	Gloucester Rail.-Car & Wagon, Ld., A, 1-29,861 & 49,751-50,900	7	[illegible] 10
41,889	7	3/6	Do. B, 29,862-49,750, 50,001-75,000	7	[illegible]
14,567	10	1/3	Lancashire Wagon, Ord. . ..	2	2 2[illegible]
4,150	10	5[illegible]	Do. do. . ..	10	10[illegible] 10[illegible]
784,808	1	9d.	Metropolitan Amalgamated Rail.-Carriage & Wagon, Ld., 1-784,808	1	[illegible] 13/9
161,288	1	6d.	Do. Cum. A Pref. 5% 1-161,288	1	[illegible] —
235,000	1	7½d.	Do. Cum. B Pref [illegible] 1 235,000	1	[illegible] 29/
[illegible]	20	20	Midland Rail.-Car & Wagon, Ld., 1-20,000	10	[illegible] — 21½

[illegible] Stock and Shares [illegible] dividend.

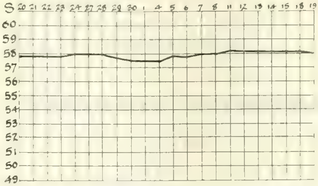
THE HOME METAL MARKET.

SHOWING DAILY FLUCTUATIONS FROM NOVEMBER 20TH TO DECEMBER 19TH, 1905.

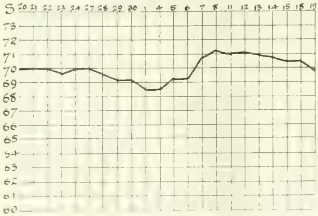
COPPER.



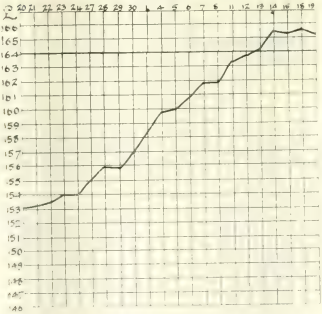
PIG IRON: SCOTCH.



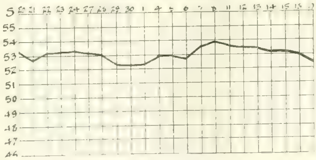
HEMATITE.



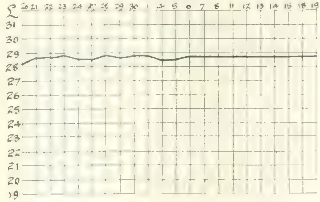
TIN.



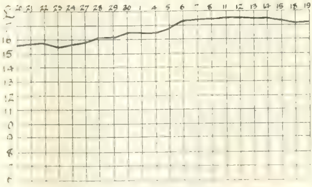
CLEVELAND.



SPELTER.



ENGLISH LEAD.



PRICES CURRENT OF COAL, IRON, STEEL, AND OTHER METALS.

MANUFACTURERS' AND MERCHANTS' QUOTATIONS.

MARKET REPORT.

Wednesday, December 20th, 1905.

COPPER shows a further sharp advance, events having moved even more rapidly than the most sanguine had ventured to anticipate. The prices ruling have exercised practically no restraining influence upon consumption, and the Amalgamated Company is stated to be unable to make any prices before April delivery. Indeed, as Merton and Company's circular points out, were it not for the fact that moderate quantities of electro-copper are being reshipped from China to Europe, the situation during the next few months would be very serious indeed. The Standard market has been very animated, and large speculative dealings are reported. At one time speculative buying and covering operations carried the price of January dates up to £81, but there has been some reaction from this, and the price has relapsed to £78 17s. 6d. cash, and £78 15s. three months.

Tin has exhibited remarkable strength, although there have been somewhat wide fluctuations in quotations. At the beginning of the week there was a sharp advance in sympathy with strong outside advices: C.i.f. transactions being reported from the East up to £167. A significant feature of the recent position has been this relatively higher price paid in the Straits and in Holland, and it is quite clear that current supplies are inadequate to meet the growing demand. The latest quotations are £164 17s. 6d. cash, and £164 three months.

Lead is somewhat easier, free offerings by English smelters having been in evidence, and although large quantities were absorbed, the market gave way on the continued offerings of metal. At the time of writing the tendency is a little unsteady with soft foreign prompt [illegible]

The speculative iron market has been in a very sensitive condition, by reason of the manipulative tactics of leading operators, and prices have fluctuated within somewhat wide limits. Cleveland has declined to 51s. 9d., with Scotch at 58s., and Hematite at 69s. 9d. Business in Hematite iron continues to be good, and it is thought by those in a position to judge that a sharp advance is likely to take place in the near future.

IRON, STEEL, PIG-IRON, &c.

SCOTLAND.

Messrs. David Colville and Sons, Ltd., Dalzell Steel and Iron Works, Motherwell, N.B., quote as follows. Prices delivered in Glasgow or equal:—

Steel:

		£	s.	d
DALZELL	Siemens' Steel Plates, Marine Boiler Quality ..	8	2	6
	,, ,, ,, Land ,, ,, ...	8	2	6
STEEL	,, Steel Bars, Boiler Quality	8	5	0
DALZELL	Siemens' Steel Plates, Ship Quality Plates... ..	7	2	6
	,, ,, Bars ,, ,, ...	7	15	0
STEEL	,, ,, Angles	6	15	0

Manufactured Iron:

Bars—Dalzell	7	2	6
,, Best	7	12	6
,, ,, Horseshoe	7	12	6
,, Angle	7	2	6
,, Best Angle	7	12	6
,, Best Best	8	2	6
,, Extra Best	8	12	6

Usual terms and extras. Special rates for delivery in England and export. The above prices subject to alteration without notice

Malleable Common Bars:	£	s.		
Dalzell, per ton	7	2	6	5 per cent
Govan	6	10	0	..
North British	6	10	0	..
Drumpellier	6	7	6	,,
Waverley ...	6	10	0	..
Crown	6	5	0	.
Dundyvan	6	5	0	.
Muirkirk	6	5	0	..
Rochsolloch	6	5	0	.
Phoenix	7	5	0	..
Coatbridge	7	2	6	..
Coats	6	5	0	..
Angle Iron ...				..
Steel Plates, ship .				..
Boiler Plates . ..				..
[illegible]				..
Railway Chairs				..

G.M.B. at Glasgow, No. 1, 64s.; No. 3, 61s.

John Spencer (Coatbridge), Ltd., Phœnix Ironworks, Coatbridge, N.B., quote .

	£	s.	d
Bars Phœnix	7	5	0
,, Best	7	15	0
,, Best Best	8	5	0
. Extra Best..................................	8	15	0
.. Best Horse Shoe	7	15	0
,. Extra B H.S.	8	15	0
.. Extra Best Cable	9	5	0
. Rivet	7	5	0
Best Scrap Rivet	8	5	0

	£	s.	d.
Angles—Phœnix	7	5	0
,, Best	7	15	0
,, Extra Best	8	5	0
Gas Tube Hoops—Phœnix Best	7	15	0
Plates—Phœnix	—		
,, Best Boiler	8	10	0
,, Best Best Boiler	9	0	0
,, Extra Best Boiler	10	0	0
Boiler Tube Strips—Phœnix	9	0	0

All per ton, delivered f.a.s., Glasgow, Greenock, Grangemouth, Granton, Leith, or Ardrossan. 5 per cent. discount cash monthly.

Messrs. R. Feldtmann and Co., of Glasgow, quote (Commission extra).

Pig Iron:

	No. 1. £	s.	d.	No. 3. £	s.	d.
Coltness, f.a.s. Glasgow	3	16	0	3	6	0
Gartsherrie ,,	3	8	6	3	3	6
Summerlee ,,	3	11	0	3	6	0
Carnbroe ,,	3	5	6	3	2	6
Langloan ,,	3	10	0	3	5	0
Calder ,,	3	7	6	3	2	6
Clyde ,,	3	8	0	3	3	0
Glengarnock, f.o.b. Ardrossan	3	8	0	3	3	0
Eglinton ,, ,,	3	3	0	3	0	0
Dalmellington, ,, Ayr	—			3	0	0
Shotts ,, Leith	3	7	6	3	2	6

NORTH OF ENGLAND.

Messrs. W. Whitwell and Co., Ltd., Thornaby Ironworks, Stockton, quote as follows, **at works:—**

	£	s.	d.
W.W. Bars	7	5	0
W.W. Best Bars	7	12	6
W.W. Best Best	8	0	0
W.W. Best Best Best	8	7	6
W.W. Best Shoe	7	15	0
Thornaby	8	15	0
Thornaby Best	9	5	0
Thornaby Best Best	10	5	0
Whitwell Special Admiralty Cable	10	15	0
Special Chain Iron	9	15	0
Tube and Nail Strip iron net cash	7	5	0
W.W. Angle Iron	7	7	6
W.W. Best Angle Iron	7	15	0
Tee Iron, to 8-inches United	8	5	0

Terms, Cash, less 2½ per cent. discount on 10th of month following delivery.

LANCASHIRE.

The Pearson and Knowles Coal and Iron Company, Ltd., Dallam and Bewsey Forges, Warrington, quote as follows:—

	Iron. £	s.	d.	Steel. £	s.	d.
Bars	7	10	0	7	15	0
Angles	8	0	0	8	5	0
(8N) Tees	8	10	0	8	15	0
Hoops	7	10	0	8	0	0
W.I.W Sheets	8	15	0	9	0	0

Ordinary Sizes, F.A.S. Liverpool in 10-ton Lots.

Extras for Sizes and Cutting as per List.

Lots under 10 cwts. of a size 10s. per ton extra.

WORCESTERSHIRE.

Baldwins Ltd. (with which is amalgamated Knight and Crowther, Ltd.), Wilden Works, near Stourport, quote:—

Black Sheets	Singles 20 G 96in. by 36in. per ton. £	s.	d.	Doubles 21 G to 24 G 96in. by 36in. per ton. £	s.	d.
"Vale"	11	0	0	12	0	0
"Shield"	11	10	0	12	10	0
"Severn"	12	10	0	13	10	0
"Baldwin Wilden B."	13	10	0	14	10	0
Charcoal	17	10	0	18	10	0
Best Charcoal	19	10	0	20	10	0

Pickled, cold-rolled and close annealed sheets specially quoted for.

Extra widths, Singles to 66in., Doubles to 56in., Lattens to 46in. Extra lengths, Singles to 168in., Doubles to 132in., Lattens to 108in.

Patent Coated Sheets:

	£	s.	d.	£	s.	d.
No. 3 Lead	14	10	0	15	10	0
S.V. Lead	16	0	0	17	0	0
No. 3 Terne	16	0	0	17	0	0
S.V. Terne	17	10	0	18	10	0

Tinned Sheets:	Singles 20 G to 108 by 36in. per ton. £	s.	d.	Doubles 21 to 24 G to 96 by 36in. per ton. £	s.	d.
Best Coke (Finish)	29	0	0	30	10	0
,, Charcoal (Finish)	31	0	0	32	10	0
Extra ,, ,,	33	0	0	34	10	0

Cotton Can Tin Sheets to 39in. by 36in. specially quoted for.

Tin Plates, "Cookley, K" Best Charcoal, £1 7s. 0d. per box.

Extreme sizes in Tin and Patent Coated specially quoted for.

Lattens up to 36 wide by 27 W.G. £1 10s. 0d. per ton extra throughout for all brands.

At works.

Galvanized Corrugated Sheets:

	£	s.	d.	
"Phœnix" Brand, 24 G., f.o.b. London, in Bundles	13	7	6	per ton.
"Blackwall" Brand, 26 G., in felt-lined cases for Australia, f.o.b. London	16	0	0	,,

Galvanized Working Up-Sheets:

	£	s.	d.	
24 G., f.o.b. London, in Bundles	14	7	6	per ton.

STAFFORDSHIRE.

Shelton Iron, Steel, and Coal Co., Ltd., Stoke-on-Trent, North Staffordshire, and 122, Cannon Street, London, quote:—

	£	s.	d.	
Crown Bars	7	5	0	per ton.
Best Bars (1 to 6in. wide, above ¼ in. thick, ½ to 4in. rounds and squares)	7	15	0	,,
Angles	7	10	0	,,
,, Best	8	0	0	,,
T's	7	15	0	,,
,, Best	8	5	0	,,
Best Shoe Iron	7	15	0	,,
,, Rivet Iron	8	15	0	,,
,, Best Rivet (Special)	10	0	0	,,
,, Cable	10	0	0	,,
,, Screwing	9	0	0	,,

	£	s.	d.	
Best Turning	7	15	0	per ton.
,, Plating	9	0	0	,,
Best Best	10	0	0	,,
Treble Best	11	0	0	,,
Plates	8	5	0	,,
Best Plates	8	15	0	,,
,, Boiler Plates	9	5	0	,,
,, Best Boiler Plates	10	5	0	,,
Treble Best Boiler Plates	12	15	0	,,

Delivery f.o.b. Liverpool, Birkenhead or Manchester.

WALES.

Cordes (Dos Works), Ltd., of Newport, Mon., quote "Star" brand patent wrought nails steel nails, &c.

Discounts—

42½ per cent. off 1-inch to 3-inch strong rose and all fine rose and 6dy. and 8dy. pound.

37½ per cent. off 3½-inch to 7-inch strong rose and 10dy. and 20dy. pound.

37½ per cent. off all sharp-pointed nails.

Delivered in lots of 4 cwt. and upwards. **Extra 2½ per cent.** discount off the gross on two tons and upwards.

Steel rose, flat points, 5-inch to 7-inch basis:—

2 tons 10/6 per cwt.
4 cwt. lots and upwards 10/9 per cwt. } d/d any Railway Station.

Steel cut nails, 3-inch to 6-inch basis—

2 tons 9/3 per cwt.
4 cwt. lots 9/6 per cwt. } d/d any Railway Station.

Slit rods (iron) £8 per ton, at works for 2-ton lots.

Messrs. Richard Thomas and Co., Ltd., of 33 and 35, Eastcheap, E.C. — Works: South Wales, Burry, Lydney, Lydbrook, and Cwmbwrla, quote:—

Coke Tin-plates.	Per Box. f.o.b. Wales. £	s.	d.
C 18¾ by 14 124s. 110 lb. "BV"	0	13	6
C 20 by 10 225s 155 ,, "Jumbo"	0	18	9
C 20 by 14 112s. 108 ,, "Lydbrook"	0	13	3
C 28 by 20 112s 216 ,, "Lydbrook"	1	6	9
Charcoal Tinplates:			
C 20 by 14 112s 108 lb. "Allaway"	0	14	0

BELGIUM.

C. L. Faulkner, Suffolk House, Laurence Pountney Hill, London, E.C., quotes:—

Prices quoted are in £ stg. and per ton of 1,015 kos. (2,240 lb.) delivered free on board ANTWERP for approved quantities.

Steel:		£	s.	d	
Blooms	at	4	2	0	per ton.
Billets	at	4	4	0	,,
Sheet Bars	at	4	6	0	,,
Finished Steel:					
Bars	at	5	15	0	per ton.
Angles	at	5	16	0	,,
Tees	at	5	19	0	,,
Joists	at	5	0	0	,,
Fencing Standards	at	5	15	0	,,
Shoeing Bars	at	5	19	0	,,
Tyre Bars	at	5	19	0	,,
Half-Round Bars	at	6	3	0	,,
Heavy Rails	at	5	10	0	,,
Light Rails	at	5	10	0	,,

Structural Steelwork:

Prices on application

METALS.

Messrs. French and Smith, 147, Leadenhall Street, and 11, Oldhall Street, Liverpool, quote:—

TIN.

Tin:	£	s.	d.		£	s.	d.	
English Ingots, f.o.b. Dis. 1½% & 1%	167	10	0	to	169	0	0	per ton
English Bars, f.o.b. Dis. 1½% & 1%	168	10	0	to	162	0	0	,,
Straits G.M.B., cash Warehouse, Net	165	5	0	to	165	7	6	,,
Straits G.M.B., 3 months, Warehouse, Net	164	7	6	to	164	10	0	,,
Australian, Mt. Bischoff, Warehouse, Net	165	15	0	to	166	0	0	,,

COPPER.

Copper:	£	s.	d.		£	s.	d.	
Standard G.M.B., cash Warehouse, Net	79	5	0	to	79	10	0	per ton
Standard G.M.B., 3 months, Warehouse, Net	78	15	0	to	78	17	6	,,
English, Tough, Cake & Ingot, Warehouses, Net	87	0	0	to	88	0	0	,,
English, Best Select, Warehouse Net	87	10	0	to	88	0	0	,,
English, Sheets and Sheathing, f.o.b., Dis. 2½%	95	0	0	to	95	10	0	,,
English, Sheets for India, f.o.b., Dis. 2½%	90	0	0	to	91	0	0	,,
Electro, Warehouse, Net	88	10	0	to	89	0	0	,,
Ore, ex. ship	0	14	9	to	0	15	9	per unit.
Regulus, Matte and Precipitate, ex ship,	0	15	9	to	0	16	3	,,

YELLOW METAL.

Yellow Metal:	£	s.	d.	
Sheets, 4 by 4 feet for India f.o.b. Dis. 2½%	0	0	7¾	per lb.
Sheathing ,, ,,	0	0	8	,,

SPELTER.

	£	s.	d.		£	s.	d.	
Silesian outports, Net	28	12	6	to	28	15	0	per ton.
Blende of 50% Net	8	0	0	to	8	7	6	,,
Calamine, Net	8	9	0	to	8	10	0	,,

LEAD.

	£	s.	d.		£	s.	d	
English Pig, Warehouse, Dis 2½%	17	5	0	to	17	10	0	per ton
Spanish, ex ship. Dis. 2½%	17	0	0	to	17	2	6	,,
Lead Ore of 70%, Net	8	10	0	to	8	15	0	,,

ANTIMONY.

	£	s.	d.		£	s.	d.	
Star Regulus, f.o.b., Dis. 2½%	60	0	0	to	62	0	0	per ton
Ore, 50%, ex ship, Dis. 2½%	12	10	0	to	15	0	0	,,
Crude, ex ship, Dis. 2½%	30	0	0	to	32	0	0	,,

QUICKSILVER.

	£	s.	d.	
Spanish, 75 lb., Warehouse, Net	7	5	0	per flask
Italian ,, ,, ,,	7	2	6	,,

COAL.

LEICESTERSHIRE.

The Nailstone Colliery Company, Leicester, quote. Price per Ton at Pit of 20 Cwt., with ½ Cwt. per Ton for wastage —

Upper Main Seam.	s.	d.
Main Coal	6	6
Best Hard Steam (hand picked, as used by the Railway Companies)	5	6
Best Hard Steam Cobbles (made through 6 in. mesh, free from slack)	6	0
Fine Slack	0	6

Terms, net cash on 10th of month following delivery.

DERBYSHIRE.

The Manners Colliery Co., Ltd., of Ilkeston, quote as follows, per ton at pit:

Kilburn Coal:	s.	d.
Best London Brights	9	3
Large Nuts (1½ to 3½)	9	0
Small Nuts (⅞ to 1½)	6	0
Peas (⅝ to ⅞)	5	0
Rough Slack	4	0
Slack	3	6
Smudge	2	0

Rutland Coal:	s.	d.
Brights (4 to 8)	7	6
Large Nuts (2 to 4)	7	0
Slack	3	6
Hand-picked Hards	7	6
Hard Cobbles	6	3

The Clay Cross Company's Collieries, Clay Cross, near Chesterfield, quote:—

	per ton at pit. s.	d.
Best Main Coal	10	6
Best Silkstone	10	0
Best House Coal	8	6
Best House Nuts	8	0
Treble Screened Cobbles	7	9
Best Cobbles	7	3

NOTTINGHAMSHIRE.

The Digby Colliery Co., Ltd., near Nottingham, quote per ton at pit:—

Digby Coal:

STEAM.	s.	d.
Best Hand Picked Hard	8	6
Steam Hard	7	3
Hard Nuts	6	6

Gedling Colliery.

HIGH HAZEL (or Ashless House Coal).	s.	d.
London Brights, 4 to 8 in. cube	11	0
Bright Cobbles (Hand Picked)	10	6
Large Nuts, 2 to 4 in. cube	10	0
Small Nuts, 1 to 2 in. cube	6	3
Pea Nuts, ⅜ to 1 in. cube	5	0

STEAM.—TOP HARD.	s.	d.
Best Hard	8	6
Hard Steam	7	6
Cobbles	6	3

CHEMICALS.

Messrs. S. W. Royse and Co., Albert Square, Manchester, quote:

	£	s.	d.	
Acids: Oxalic	0	0	2½	per lb
Picric, Crystals	0	0	11	,,
Tartaric .... at Manchester	0	0	10⅞	,,

	£	s.	d.	
Acetate of Lime: Brown at Manchester net	8	10	0	per ton.
Grey ,,	11	15	0	,,
Alumina: Alum, Lump, loose	5	5	0	,,
,, ,, in casks	5	7	6	,,
,, Ground, in bags	5	15	0	,,
Sulphate of Alumina, 14%	4	10	0	,,
Ammonia: Carbonate	0	0	3⅝	per lb.
Muriate Grey f.o.b. Liverpool	24	15	0	per ton.
Sal-ammoniac, Lump, 1sts, deld. U.K.	42	0	0	,,
,, ,, 2nds, ,,	40	0	0	,,
Sulphate .... f.o.b. Liverpool	12	18	0	,,
Arsenic: Best White Powdered ....net	15	0	0	,,
Bleaching Powder, 35% .... ,,	4	7	6	,,
Borax: British Refined Crystal......... ,,	13	0	0	,,
Coal Tar Products:				
Benzole, 50/90 % ,,	0	0	8½	per gal
,, 90% ,,	0	0	9	,,
Carbolic Acid Crystals, 34/35° C. ... ,,	0	0	6	per lb
,, ,, ,, 39/40° C. ... ,,	0	0	6¼	,,
,, ,, Liquid, 97/99 % ... ,,	0	0	9	per gal.
,, ,, Crude, 62½% at 60°F. f.o.b. ,,	0	1	10	,,
Creosote, ordinary good liquid...... ,,	0	0	1⅞	,,
Naphtha, Crude, 20 % at 120° C.... ,,	0	0	4	,,
,, Solvent, 90% at 160° C. f.o.b ,,	0	1	0	,,
,, ,, 95 % at 160° C. ,, ,,	0	1	0½	,,
,, ,, 90 % at 190° C. ,, ,,	0	1	1½	,,
,, Rectified, flash point over 73° F. ....f.o.b. ,,	0	1	1½	,,
,, Rectified, flash point over 100° F. ....f.o.b. ,,	0	1	2½	,,
Naphthalene, all qualities.				
Pitch..............f.a.s. Manchester. ,,	1	12	6	per ton.
Copperas: Green, in bulk .... ,,	0	12	6	,,
,, barrels f.o.b. L'pool ,,	1	18	6	,,
Cake ,,	1	1	6	,,
Copper: Sulphate	25	0	0	,,
Cyanides: 98% minimum ......f.o.b. net	0	0	8¼	per lb.
Lead: Acetate (Sugar) White, English......	28	0	0	per ton.
,, ,, ,, Foreign c.i.f. U.K	25	5	0	,,
,, ,, Grey	23	10	0	,,
,, ,, Brown at Manchester	19	10	0	,,
Nitrate	26	10	0	,,
Litharge, Flake	18	10	0	,,
,, Powder	19	0	0	,,
Red Lead, Genuine, c.i.f London less 5%	19	0	0	,,
White ,, ,, Dry ,, ,, ,,	20	0	0	,,
Naphtha (Wood): Miscible, 60 o.p..........	0	2	4	per gal.
Solvent	0	2	7	,,
Potash: Bichromate... delivered England...	0	0	3	per lb.
Carbonate, 90/92 % ... c.i.f Hull ...	17	15	0	per ton.
Caustic, 75/80 % ...... ,, ,, ...	19	5	0	,,
Chlorate ....net	0	0	3¼	per lb.
Montreal.........in Store, Liverpool	31	10	0	per ton.
Prussiate Yellow .... net	0	0	4⅝	per lb.

	£	s.	d.	
Soda: Ash, Caustic, 48 .. Ordinary .. net	5	5	0	per ton.
,, ,, ,, Refined...... ,,	6	5	0	,,
,, Carbonated, 48 %........... ,,	5	10	0	,,
,, ,, 58 % (Ammonia Alkali) ....net	4	10	0	,,
,, Bleachers' Refined Caustic 50/52 % .... net	6	10	0	,,
Caustic, White, 77 %.............. ,,	10	12	6	,,
,, ,, 70 %.............. ,,	9	12	6	,,
,, ,, 60 %.............. ,,	8	12	6	,,
,, Cream, 60 %..... .. .. ,,	8	10	0	,,
Crystals, in bags	3	0	0	,,
,, barrels	3	7	6	,,
Acetate .... c.i.f. Hull net	16	15	0	,,
Bicarbonate, in 1 cwt. kegs...........	6	15	0	,,
Bichromate......delivered England...	0	0	2¼	per lb.
Chlorate .... net	0	0	3½	per lb
Nitrate...ex quay Liverpool, ... ,,	11	0	0	per ton.
Phosphate	9	5	0	,,
Prussiate ....net	0	0	$3\frac{7}{16}$	per lb.
Silicate, Solution, 140° Tw.	4	10	0	per ton.
Sulphate (Glauber Salts)...............	1	10	0	,,
,, (Saltcake, 95%)................	1	15	0	,,
Sulphur: Recovered	4	15	0	,,
Roll	6	15	0	,,
Flowers......................................	7	10	0	,,
Zinc: Sulphate	6	15	0	,,
Shellac: Standard TN orange spot	9	10	0	per cwt.

MINERALS.

Messrs. S. W. Royse and Co., quote :—

	£	s.	d.	
Barytes: Lump Carbonate, 90/92%	3	10	0	per ton.
Sulphate, No. 1, White	2	15	0	,,
China Clay: of various qualities for all purposes; prices from about 11/- to about 30/- per ton, f.o.b. Cornwall: stocks also kept at Runcorn and Preston. Quotations given carriage paid.				
Chrome Ore: Basis 50% c.i.f. British Ports..........	3	10	0	,,
Manganese: Lump c.i.f. Liverpool 10¼d. per metallic unit.				
Ochre: French JC .... f.o.b. Rouen, net	2	5	0	per ton.
,, JF	5	10	0	,,
Talc: (French Chalk).........c.i.f. Liverpool	3	10	0	,,

Messrs. Henry Bath and Son, quote :—

	£	s.	d.		£	s.	d.	
Copper, Ores of, 10 to 25%,	0	13	3	to	0	14	3	per unit.
Regulus, 45 to 55%, ...	0	14	3	to	0	14	9	,,
Precipitate, 65 to 80% ...	0	14	4½	to	0	14	10½	,,
Tin Ores, 70%	95	0	0	to	97	0	0	per ton
Lead Ore, 70%					8	0	0	,,
Blende, 50%					8	6	6	,,
Calamine.......................					8	9	0	,,
Antimony, Star Regulus	48	0	0	to	50	0	0	,,
,, Ore 50%......	12	10	0	to	15	0	0	,,

Messrs. Barrington and Holt, Cartagena, quote :—

Iron Ore

		s.	d.	
Ord. 50 [illegible] ... f.o.b	Porman	7	8	per ton.
Do .... ,,	Cartagena	8	0	,,
Special low ph[illegible] ,,	Porman			
Do. [illegible] ,,	Cartagena.......	8	2	,,
Extra quali[illegible]	,, ...	8	6	,,
Special Iron Ore ,,	,, ...nominal			,,
Specular 58[illegible] ,,	....	11	0	,,
S. P. Cam[illegible] ,,		9	6	,,

TIMBER.

Messrs. Alfred Dobell and Co., Liverpool, quote :—

COLONIAL WOODS.

Timber.

		£	s.	d.		£	s.	d.
Quebec Square White Pine...	per cub. ft.	0	1	9	to	0	3	3
Quebec Waney Board Pine...	,,	0	2	8		0	3	9
St. John Pine, 18 in. average	,,	0	2	4		0	3	3
Lower Ports Pine...............	,,	0	1	3		0	1	8
Quebec Red Pine	,,	0	1	6		0	2	3
Quebec Oak, 1st quality	,,	0	2	9		0	3	4
Quebec Oak, 2nd quality ...	,,	0	1	6		0	2	6
Ash	,,	0	1	6		0	2	3
Elm	,,	0	3	3		0	4	0
Hickory	,,	0	2	0		0	2	6
Quebec Birch	,,	0	1	6		0	2	3
St. John Birch	,,	0	1	6		0	2	0
Birch Planks...................	,,	0	0	9		0	0	11
Spruce Spars	,,	0	0	10		0	1	0

Deals.

		£	s.	d.		£	s.	d.
1st quality Quebec Pine	per std.	22	10	0	to	32	10	0
2nd do. do.	,,	17	0	0		22	0	0
3rd do. do	,,	11	10	0		13	0	0
St. John, Miramichi, etc., Spruce	,,	7	10	0		7	15	0
Nova Scotia Spruce..	,,	7	7	6		7	12	6
Spruce Boards.................	,,	6	7	6		6	12	6

UNITED STATES, etc., WOODS.

Pitch Pine.

		£	s.	d.		£	s.	d.
Hewn	per cub. ft.	0	1	4	to	0	1	8
Sawn	,,	0	1	0		0	1	6
Planks, Stowage	,,	0	0	10		0	1	0
Boards, Prime	per std.	12	10	0		16	0	0
Oak Timber	per cub. ft.	0	1	6		0	2	6
Oak Planks	,,	0	1	6		0	2	1
East India Teak..............	per load	12	0	0		19	0	0
Greenheart.....	,,	6	15	0		7	10	0

EUROPEAN WOODS.

Timber.

		£	s.	d.		£	s.	d.
Riga Redwood	per cub. ft.	0	1	6	to	0	2	0
Dantzic and Memel Fir, Crown	,,	0	2	1		0	2	6
Dantzic and Memel Fir, Middling	,,	0	1	9		0	1	11
Stettin	,,	0	1	9		0	1	11
Swedish	,,	0	1	0		0	1	3
Riga Whitewood	,,	0	1	0		0	1	3
Norway Mining Timber	,,	0	0	9		0	1	0
Dantzic and Stettin, etc., Oak..	,,	0	2	6		0	3	0
Norway Spars..................	,,	0	1	2		0	1	9

Deals.

		£	s.	d.		£	s.	d.
Red Archangel and Onega, 1st quality	per std.	19	0	0		20	0	0
Red Archangel and Onega, 2nd quality	,,	14	0	0		16	0	0
Red Archangel and Onega, 3rd quality	,,	10	10	0		12	10	0
St. Petersburg, 1st quality...	,,	16	0	0		17	10	0
Do. 2nd ,, ...	,,	14	0	0		15	0	0
Gefle	,,	11	10	0		16	0	0
Wyburg	,,	11	0	0		12	10	0
Uleaborg	,,	10	0	0		12	10	0
Gothenburg	,,	11	0	0		16	0	0

SELECTED PATENTS.

NEW PATENTS APPLIED FOR.

(December 4th—9th.)

ENGINEERING—CIVIL, MECHANICAL, ETC.

25,078 WHITE and POPPE, LTD., and PETER AUGUST POPPE, Birmingham.—Improvements in clutches for transmitting power.

25,093. W. BALLEWSKI, Berlin.—Steam superheater.

25,101. H. ROBINSON, Manchester.—Improvements in or relating to the blades or vanes of fluid pressure turbines.

25,103. L. GALLIMORE and S. WATSON, Glasgow.—Improvements in or connected with means for preventing or consuming smoke in the furnaces of steam generators.

25,130. B. J. B. MILLS, London.—Improvements in shaft packing.

25,134. L. R. CAYLEY and L. P. EDWARDS, London.—Improvements in or connected with steam or other fluid pressure turbines.

25,137. J. HODSON, London.—Improvements in gripping devices or chucks.

25,138. A. W. PRENTICE and A. SHIELS, London.—Improvements in or relating to driving mechanism.

25,141. N. A. H. ABEL, London.—Improvements in or relating to cranes.

25,150. H. C. VOGT and H. G. DORPH, London.—Improvements in steam boilers.

25,168. L. KRIEGER and CIE. PARISIENNE DES VOITURES ELECTRIQUES (PROCEDES KRIEGER), London.—Improved means for securing wheels on shafts.

25,176. J. S. RUSTON and O. RECKE, London.—Improved means for governing engines.

25,180. F. P. CANDY, London.—Improvements in or in connection with driving belts.

25,189. E. V. DU BOULAY, Ryde.—Improvements in pumps and compressors used for liquids or gases especially in connection with internal combustion motors.

25,194. J. VOST, Glasgow.—Improved mechanism for actuatng the chain grates of furnaces.

25,221. H. SMITH and Co., Ltd., H. SMITH and O. SMITH, London.—Improvements in or relating to hydraulic presses and like hydraulic machines.

25,226. C. A. ALLISON, London.—Improvements in thrust bearings and the means for lubricating the same. (Montauk Engineering Company, United States).

25,254. J. C. BOWRING, London.—Improvements in and relating to furnace grates for steam power production and other purposes.

25,264. H. H. LAKE, London.—Improvements in governor heads. (The Pickering Governor Company United States).

25,267. G. DE SIMONE, FU GIOVANNI, London.—Improvements in quick-acting safety and precision valves.

25,280. J. H. THOROUGOOD, Liverpool.—Improvements in or appertaining to the simultaneous regulation of the supply of fuel, water and induced draught for steam generators.

25,281. W. MICHALK, Liverpool.—Improvements in or relating to steam lubricating apparatus.

25,284. W. P. SCHERER, London.—Improvements in tender for locomotives.

25,297. J. W. SMITH, London.—A new and improved steam turbine.

25,313. C. J. ATKINSON, Manchester.—Improvements in suction gas producers.

25,337. J. BROOMFIELD, Peebles.—A pipe cutter.

25,352. A. P. BOSSERT, London.—Improvements relating to floors, ceilings and walls constructed of artificial stone and like materials, reinforced with metal.

25,366. E. KLIMM, Liverpool.—Improvements in and connected with the furnace arrangement of steam engines.

25,367. J. P. HISPA, Liverpool.—Improvements in automatic releasing or opening mechanisms for grab buckets having a block and tackle arrangement.

25,379. P. LORILLARD, London.—Improvements in and relating to conveyors.

25,380. P. LORILLARD, London.—Improvements in and relating to conveyors.

25,386. W. M. STILL and A. G. ADAMSON, London.—Improvements in or relating to steam heating systems.

25391. SOCIETE L'ECLAIRAGE ELECTRIQUE, London.—Multicellular centrifugal turbine pump.

25,419. J. CLELAND and J. C. STEWART, Belfast.—Improvements in or relating to pressure regulators.

25,433. J. McKENZIE, Glasgow.—A means for operating punching machines.

25,436. A. SPRECKLEY, Nottingham.—Improvements in gearing.

25,445. B. A. THOMAS, BIRMINGHAM.—Improvements in grate bars for boilers and other similar furnaces.

25,449. R. MOTION, Glasgow.—Improvements in apparatus for maintaining a supply of heated water and for raising steam therefrom or from a part thereof.

25,453. I. J. HADDON, London.—Improved tube cutter.

25,484 B SCHAFFER, London.—Improvements in or relating to steam engines.

25,488. W. H. RUSSELL, London.—Improvements in roller bearings.

25,500. W. PINER, London.—An improved means for securing the gudgeon pins of explosion or like engines.

25,505. J. N. PAXMAN and H. G. PLANE, London.—Improvements in or relating to tubular boilers or steam generators.

25,506. J. N. PAXMAN and H. G. PLANE, London.—Improvements in or relating to tubular boilers or steam generators.

25,508. C. J. KLEIN, London.—Improvements in means for converting motion.

25,543. R. REEKIE, Edinburgh.—An improved metal packing.

25,562. W. WERRY, London—Improvements in locomotive engines.

25,563. W. WERRY, London.—Improvements in steam and other pressure engines.

25,578. S. MONTGOMERY, London.—A new or improved compression indicator for internal combustion engines.

25,582. H. F. FULLAGAR and J. F. BOTTOMLEY, London.—Improvements in internal combustion engines of the turbine type.

25,588. C. C. DODGE, London.—Improvements in lubricators.

25,603. F. C. ROBERTS, London.—Furnace charging apparatus

25,[illegible]. C. A. CARUS-WILSON, London.—A method of and apparatus for reducing the tractive résistance of trains or vehicles running on rails.

25,611. C. M. FERGUSON, London.—Improvements in connection with steam superheaters.

25,621. W. CHADWICK, Bury.—Improved lubricator, for shaft bearings or removable machinery.

25,624. F. BOES, Düsseldorf.—Waste-steam refiner.

25,625. C. SCHMID, Düsseldorf.—Pressing devices for the manufacture of seamless pipe-fittings.

25,627. H. SCHOFIELD, Halifax.—Improvements in Corliss valve gear for steam engines.

25,634. B. R. ROWLAND, Manchester.—Improvements in apparatus for superheating steam.

25,671. T. ROBINSON, London.—Improvements in or relating to metallic packing.

ELECTRICITY.

25,147. ELEKTRIZITATS-AKTIEN-GESELLSCHAFT, VORM. W. LAHMEYER and Co., London.—Improvements in connection with the regulation of alternating current motors.

25,153. SOC. INDUSTRIELLE DES TELEPHONES, CONSTRUCTIONS ELECTRIQUES, CAOUTCHOUC CABLES, London.— Improvements in appliances for protecting electric apparatus against currents of excessive strength or voltages.

25,171. L. KRIEGER, London.—Improved means for controlling an electric motor.

25,236. ALLEGMEINE ELEKTRIZITATS-GESELLSCHAFT, London.—Improvements in and relating to Nernst lamps.

25,287. A. J. PETERSSON, London.—Method of and apparatus for striking electric arcs between electrodes.

25,288. A. F. STREET, London.—Improvements in electric signalling apparatus.

25,347. J. H. C. BROOKING and E. A. CLAREMONT, London.—Improvements in electric cut-outs.

25,361. P. J. C. DAY and B. WIESENGRUND, London.—Improvements in electrically driven hydraulic pumps for operating lifts, cranes and the like.

25,393. ELEKTRIZITATS-AKTIEN GESELLSCHAFT, VORM. W. LAHMEYER and Co., London.—A device for limiting the speed of series alternating current electro-motors.

25,405. THE BRITISH THOMSON-HOUSTON COMPANY, LTD., London.—Improvements in and relating to systems of electrical distribution. (General Electric Company, United States).

25,490. SIR O. J. LODGE, and A. MUIRHEAD London.—Improvements in and relating to wireless telegraphy.

25,512. THE BRITISH THOMSON-HOUSTON COMPANY, LTD., London.—Improvements in and relating to controlling apparatus for electric circuits. (The General Electric Company, United States.)

25,550. T. H. LARGE, Glasgow.—An improved electro-magnetic power hammer, drop stamp, or press.

25,561. S. VON AMMON, London.—Improvements in and relating to methods of cooling and ventilating electric machines.

25,614. CALLENDER'S CABLE and CONSTRUCTION COMPANY, LTD., and J. C. A. WARD, London.—Improvements in fuse and switch mechanism.

25,636. S. SIMS, Keighley.—Improved means for preventing the "live" wires of electric tramways from descending to the common danger of pedestrians and others when broken or severed.

25,641. L. ANDREWS, Manchester.—Improvements in and relating to electrical distributing systems.

25,670. THE N. S. ELECTRIC STORAGE COMPANY, and J. T. NIBLETT, London.—Improvements in or relating to secondary or storage batteries.

SHIPBUILDING, ETC.

25,[illegible]. R. BELL, Ewell.—Improvements in the appliances for the removal of marine growths from ships' bottoms and other submerged surfaces.

25,190. M. W. WALTERS, Liverpool.—Improvements in screw propellers.

25,216. R. WILCOX, London.—Improvements in ships and in propellers for the same.

25,265. H. N. GOODWIN, London.—Improvements relating to exhaust devices for marine engines.

25,336. A. KESSON, Rutherglen, N.B.—Improvements in and connected with feedwater filters and oil-extractors applicable to marine and other engines.

25,384. PALMER'S SHIPBUILDING and IRON COMPANY, LTD., and A. E. LONG, London.—Improvements in the construction of ships.

25,383. F. SCHNEIDER, London.—New or improved receiving apparatus for explosive submarine and land mines operated by electric waves.

25,475. J. P. SNEDDON, London.—Improvements in and relating to marine type water-tube boilers.

25,608. L. BADIER and H. BELART, Lyon.—Improvements in propellers.

MINING.

25,107. E. A. HAILWOOD, Morley.—Improvements in gauzes of miners' safety lamps.

25,058. R. H. ANDERSON, London.—Improvements in rock drills

25,234 J. GEIL and LINDNER, London —A new or improved foldable door for cages and the like.

25,431. D. A. JONES, Glamorgan.—Improvements in the method of compressing lead plugs used for locking safety lamps or the like.

25,546. ANDERSON, BOYES and Co., Ltd., and J. B. SHIELD, London.—Intermittent and variable silent feed mechanism for coal cutting and other machines.

IRON AND STEEL.—METALLURGICAL.

25,120. J. RODDA, S. RODDA and P. RODDA, Camborne.—Improvements in machinery for extracting the metals from tin and other pulverized ores.

25,122 N. V. HYBINETTE, London.—Process of separating metals.

25,174. SOC. ANON. ELECTROMETALLURGIQUE (PROCEDES PAUL GIROD), London.—Improvements in electric furnaces.

25,245. W. W. FYFE, London.—Improvements in and relating to ore-roasting furnaces.

25,252. C. T. SCHOEN, London.—Improvements in and relating to the art of manufacturing forged car wheels.

25,328. W. SPENCER, Crosshills, near Keighley, Yorks.—Improvements in carriers for foundry ladles and the like.

25,434. T. LEWIS, Glasgow.—Improved means for turning or adjusting the position of metal bars whilst in the process of manufacture.

25,477. G. MUTH, London —Improvements relating to the production of aluminium oxide from bauxite.

25,532. E. GUNNILL, Hull.—An improved device for use in connection with patterns for moulding purposes.

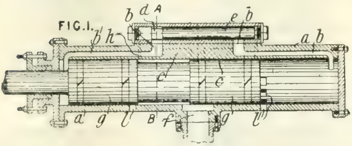
25,601. G. H. MACKILLOP, London.—Improvements in apparatus for pulverising crushing, stamping and other operations performed by a weight, or weights, which is, or are, lifted and then allowed to fall.

25,672. J. TURTON, London.—Improvements relating to the extraction of metals from their ores.

RECENT SPECIFICATIONS.

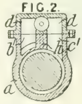
W. Jenkins, Redruth, Cornwall.—18,170. August 22nd, 1904.—Relates to rock drills actuated by steam or compressed air, the supply of fluid being controlled by the joint action of a suitably formed piston and a plain cylindrical valve. In figs. 1 and 2, a longitudinal section and a section

FIG. 1.



on the line A-B respectively, a rock drill cylinder *a* is formed with ports b, b^1, c, c^1, the last serving to lead compressed air from an inlet *f* to chambers *d* in a valve-chest containing a valve *e*, the supply being controlled by the ends of a piston *g*, which cover or uncover the ports c, c^1. In the position shown, air enters at the inlet *f*, flows around the annular groove through a bye-pass *h* into the chamber *d* and throws

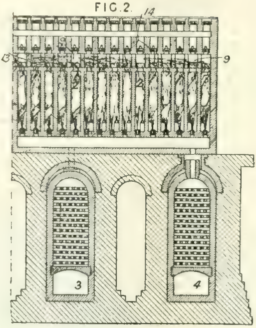
FIG. 2.



over the valve *e*. At the same time the ports c^1 is uncovered and air may flow through the port b^1 into the space behind the piston, the air in front of which exhausts through ports l^1. In travelling to the right, the piston closes the bye-pass *h*, the port c^1, the port l^1, and the bye-pass at the opposite side, and places the valve and piston in such respective positions as to be capable of performing a stroke in the reverse direction.

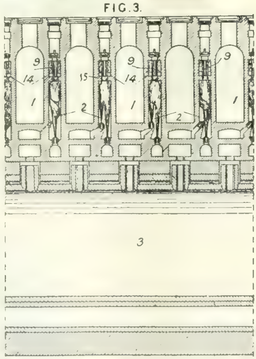
H. Koppers, Essen-on-Ruhr, Germany. 18,262, August 23rd, 1904.—Relates to coke ovens.—The regenerative furnace shown in figs. 2 and 3 has the cross-section of the horizontal passage 9 for the combustion gases and that of the vertical heating-flues 2 proportioned to, or corresponding to, the combustion gases passing through. The restrictions presented by the heating-flues are formed by projections of the bond courses, or in other suitable manner. They are narrow at the point of attack of the chimney draught and widen out towards the parts of the heating-flue group further removed. The recesses 13 between the separate heating-flues are made smaller in cross-section at points removed from the chimney, so that the heating-flue restrictions are narrow at the wide part of the horizontal passage and wide at its narrow part. Slides 14 or the like permit of adjusting the

FIG. 2.



apertures of the heating-flues. In the flues, the air ascends vertically in one angle of the flue and the gas in the opposite angle, the nozzles being interchangeable to allow the quantities of gas and air to be regulated. The gas and air supply may be positively guided by the arrangement described in Specification No. 17,283,

FIG. 3.



1903. The combustion zone is displaced to the summit of the coal charge. As is usual, the coke chambers 1 and the heating-flues 2 are built over the air and gas regenerators 3, 4.

NEW PUBLICATIONS.

"TELEGRAPHY."

A detailed exposition of the Telegraph System of the British Post Office. By T. E. Hubert, A.M.I.E.E. Whittaker and Co. 6s. 6d. net.

Although in a work of this nature, which was designed to meet the requirements of those who are preparing for departmental, or City and Guilds of London examinations, we did not expect to find anything new, nevertheless we weie surprised to find it so complete and up-to-date. Mr. Hubert not only handles his subject with precision, but also with a perspicuity which will ensure for his book a cordial reception from all interested in telegraphy. The fundamental laws of the science having been explained, the author deals successively with primary cells, circuits and conductors, galvanometers, resistance coils, and shunts; battery testing; single current systems and relays; capacity, condensers, and the double current sounder; the differential duplex; the quadruplex; the Wheatstone automatic system; the bridge duplex; the Wheatstone a b c and Steljes recorder; Hughes electromagnet, etc.; telegraph switching system; secondary cells; universal battery system, theory and power arrangements; alterations in the circuit connections for universal battery working; repeaters, test box and protective devices; Eden morning test; localisation and special testing and the formation of special circuits; the construction of aerial lines and the construction of underground lines. The Murray automatic system is adequately dealt with in the appendix—a section which covers all the latest practice. Over five hundred illustrations are included in the volume, which is one that promises to become recognised as a standard work on the subject.

BOOKS RECEIVED.

"Regulations relating to the Royal College of Science, the Royal College of Art, and to Museums under the Board of Education. (Wyman and Sons. 6d.). It is probable, states this useful compilation, that in the course of the next two or three years, various changes will be made in the organisation and relations of the Royal College of Science, including the Royal School of Mines. Notice is given that the arrangements detailed in this prospectus are subject to such alterations as may be determined in respect of the classes for the college session, 1905–6, and of courses of study in future.—"The Bulletin of the Imperial Institute" (Vol. III., No. 3, 1905. 1s.) contains some interesting data on the utilisation of sands containing thorium minerals.—"Transactions of the Civil and Mechanical Engineers' Society," edited by A. S. E. Ackerman, B.Sc. (published by the Society at 25, Victoria Street). An excellent portrait of the president is included in this volume of transactions—a selection of the papers have already appeared in PAGE'S WEEKLY. —"The Handyman's Book of Tools, Materials, and Processes employed in working Wood and Metal." Edited by Paul N. Hasluck (Cassell and Co., Ltd., to be completed in forty-eight weekly parts, 3d.). Mr. Hasluck's signature on a technical publication is sufficient guarantee of its practical utility; this re-issue of a work which we have already noticed should meet with a wide circulation.—"Journal of the Institution of Engineers of River Plate" (published in Buenos Ayres). Among other matter discussed in this journal are refuse destructors and the shortcomings of the metric system.

CATALOGUES, ETC.

The Incandescent Electric Lamp Company, Ltd., have favoured us with several neat little whist markers, which should be particularly useful at the present season, and will also serve to remind users of the merits of the "Whytelite" lamp.

David Bridge and Co., Castleton Ironworks, Manchester.—In presenting their new and revised illustrated catalogue and price lists of Heywood and Bridge's improved patent friction clutches—combining several patents—shafting, gearing and hauling installations, Messrs. David Bridge and Co., have arranged that any size of clutch, etc., can be ascertained with a minimum of trouble. We are reminded that they have secured a suitable plot of land in Castleton, and built new works with a full equipment of labour-saving tools. These friction clutches are referred to in detail in another part of the paper.

From the "Only" Sanitary Appliances Syndicate, 68, Victoria Street, S.W.—We have received some interesting details of the system employed by the firm in connection with their valve store system and sanitary appliances, with a view to counteracting water hammer and concussion. Two valves are employed, the most important being the check non-return concussion preventing valve, by which the water is prevented from re-entering the main. Concussion is prevented and service pipes are protected from contamination. As the cistern is filled or water withdrawn, air freely leaves or enters through an air escape and float valve. When the cistern is filled, the rising water lifts the float to its seating and continues to enter until the pressure is equal both in pipes and cistern. The formation of the cistern renders it self-cleansing. The non-return valve is inserted for the purpose of preventing fouling of the mains, and may be inserted in the horizontal supply pipe or vertically. Another advantage of this arrangement is, that it acts as a safeguard against the bursting of pipes in the winter. It is pointed out that each room, floor, etc., can be isolated by means of the non-return valve, which also offers protection against the spreading of infectious diseases. This valve is available as a foot-valve, or as head or lower retaining valve, and we understand that the construction has been applied to pump buckets. The air valve is applicable for use in any position, either for hot water or any other liquid. Among other specialities of the firm are a flood prevention valve and a new chemical fire extinguisher.

We have also received circulars, etc., from the following: Mavor and Coulson, Glasgow, The Pick-Quick electric coal-cutter; Herbert Morris and Bastert, Ltd., Loughborough, spur-gear pulley block; John Spencer, Ltd., Wednesbury, wrought-iron gas, steam and water tubes and fittings.; Alley and MacLellan, Ltd., Glasgow, "Sentinel" air compressors; Positive Rotary Pumps, Ltd., Northumberland Avenue, W.C., electric pumps, steam pumps, etc.; Andrew Brown, 110, Cannon Street, E.C., perforated plates, etc.; W. and T. Avery, Ltd., Birmingham, patent combination "Motor Wagon" weighbridge; Midland Manufacturing Company, Ltd., Sheffield, hand tools; Pitt and Scott, Ltd., 25, Cannon Street, E.C., shipping rates to principal places abroad.

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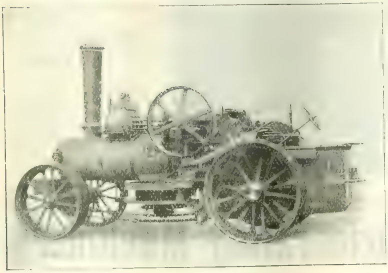

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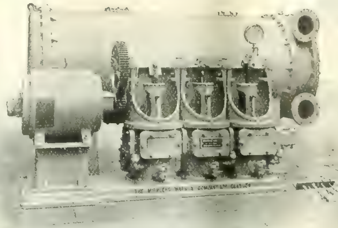
PAGE'S WEEKLY **Oil Engines, &c.**



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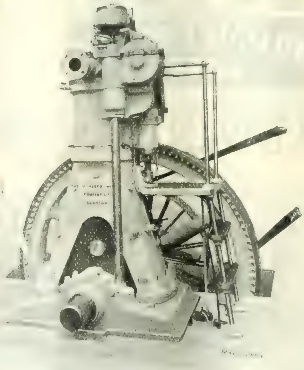

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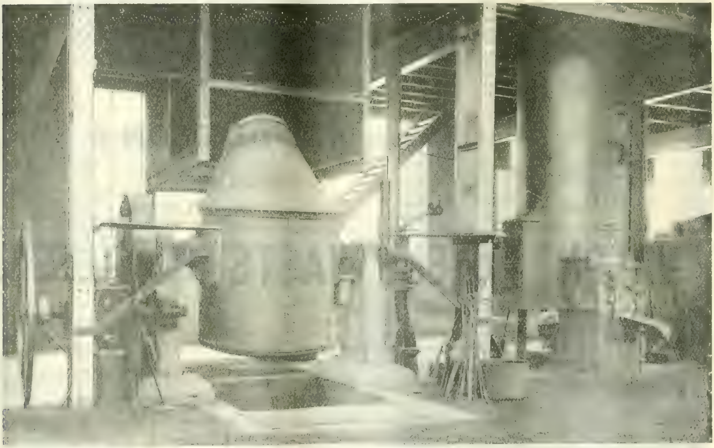

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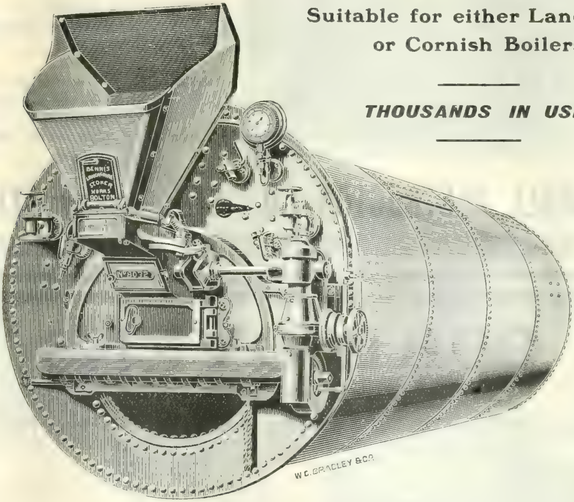

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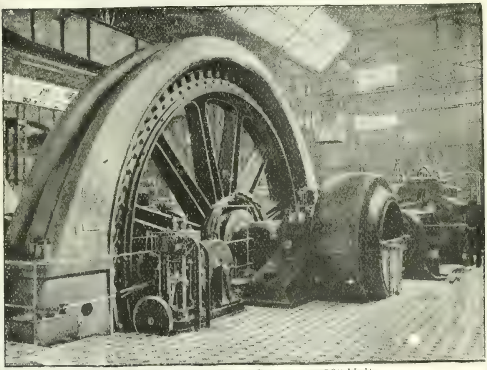

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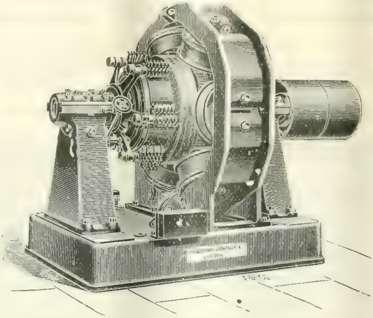

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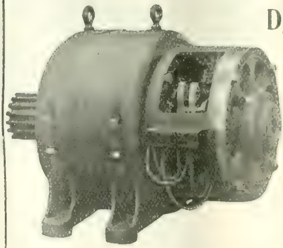

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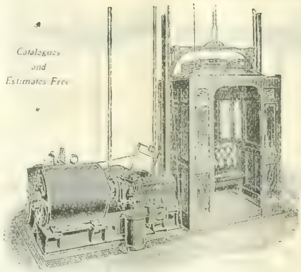

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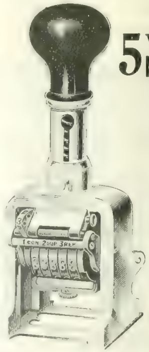

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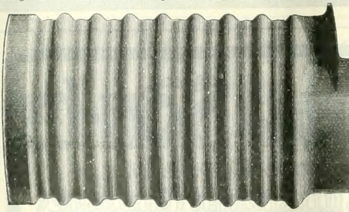

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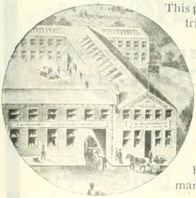

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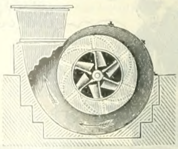

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